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ANNOUNCEMENTS.

FEILDEN'S MAGAZINE is published at the *beginning* of every month.

In consequence of the large number of pages to be prepared and passed for press, the careful nature of the printing required for high-class production, the advance arrangements made for extensive circulation, and in order to facilitate departmental business, observance of the following rules is necessary :—

Literary Matter to reach the offices not later than the 1st of the month (as much earlier as possible) previous to date of publication. Communications to be addressed "Editorial Department."

Advertisements intended for insertion in next issue must be received not later than the 15th of the month (as much earlier as possible), to insure correct classification. All communications respecting same to be marked "Business Department." Advertising Rates, on application, regulated according to positions available.

Subscriptions and letters with reference to copies to be marked "Subscription Department."

The Annual Subscription to FEILDEN'S MAGAZINE is 12s. 6d. (post free) the world over. Single copies : on art paper, 1s., by post, 1s. 4d. ; on ordinary good printing paper, 6d., by post, 9d. Subscribers are entitled to the best (art paper) copies and to all special issues.

For Buyers' Guide, Index to Advertisers, and Directory of leading British Manufacturers, see pages ii. and iv. of second cover, and pages iii. to xiv. (in first part of Magazine).

All communications to be addressed

FEILDEN PUBLISHING CO.,
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ARTICLES BY EXPERTS THAT WILL APPEAR IN THE NEXT AND SUCCEEDING ISSUES OF "FEILDEN'S MAGAZINE."

Electric Fires.
The Federation of Labour Unions.
The Town Refuse Problem.
The Motor Car and its Future.
Heat of Combustion of Hydro-Carbon Gases.
Railway Rolling Stock of High Capacity.
Town Lighting by Electricity.
The Construction of Docks.
Foundry Cupolas.
Modern Fast Cruisers.
High-Speed Steam Engines.
Modern Stone-Working Machinery.
Tea Manufacture, etc., etc.

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THE EDITOR will be pleased to consider Literary Contributions dealing with subjects within the purview of this Magazine, and to make satisfactory arrangements with Contributors if MSS. be accepted for publication. High-class engravings from photos and drawings will be prepared free of cost to the writer.

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Our Imperial Interests.

"Our only security lies in our own ability not to allow a blow to be struck at the heart of the Empire, or England's history will be at an end."—Rt. Hon. the Marquess of Salisbury.

"We love formidable competitors . . . . . Every country is trying to tread upon our heels . . . . . It behoves not only the Government, but all who in science or manufacture could help them, to do their best to place, in this respect, the preparations of the nation upon the highest level of manufacturing and scientific perfection."—Rt. Hon. G. J. Goschen, M.P.

THE heart of Britain has been profoundly touched by the magnificent sentiment so eloquently and practically demonstrated in every part of our dominions in relation to our troubles in South Africa. It may be largely due to the force and sincerity of that sentiment that issues even greater than the struggle now pending are not facing Great Britain at the present moment. The signal "Danger" was raised and at once a band as of fire went round the earth and Britain became an Empire in fact. That is the position to-day, and unquestionably the display of sympathy and patriotism shown by the Colonies, and the recognition by our brethren over seas that we are joint holders in a common heritage which no sacrifice in blood or money is too great to conserve, has held the countries of the world in admiration and amazement. To them it is doubtless inconceivable and the last thing to be expected, or, from their standpoint, to be desired. To us it is everything, and we must see to it that the efforts and sacrifices made are not lost.

The merest schoolboy must be aware that at the present moment Great Britain is apparently the most cordially disliked country on the face of the earth. The reason is not far to seek. It is the same with nations as with individuals. Progress, assertiveness and strength, particularly when developed in an extraordinary degree, invariably create feelings of jealousy and enmity; and history, contemporary and otherwise, gives us numbers of instances where men and countries have fallen from their high estate by the machinations and intrigues of those who aspire to a similar position and stop at nothing in their attempts to attain it.

It is sincerely to be deplored that such a feeling as is known to exist with regard to this country, does exist, for, in spite of anything that may be adduced to the contrary, the evidence is all too apparent, as Lord Salisbury put it recently at a public meeting, that there is at the present moment an intense prejudice against England which sticks at no resources of invention or exasperation in order, if possible, to damage our position in the eyes of the world. The Prime Minister is not able, or does not seek to explain why, whilst the conduct of foreign Governments has been so uniformly decorous and respectful, a large and noisy section of the population of these countries has been, both covertly and openly, working against us and unjustifiably seeking to stir up strife. FEILDEN'S MAGAZINE has offered the explanation which, to our mind, is the only logical one in this connection, and there is little room for doubt but that the advance of the industrial prosperity and the widespread and increasing commercial interests which this country possesses in every part of the habitable globe, is as much at the root of the feeling as our wealth and strength, those two factors which *that* prosperity and *those* interests have built up through the centuries by the enterprise of our forefathers.

Whether it be merely the vapourings of those who have to satisfy the "exigencies of the journalists of the moment" or whether, as Lord Salisbury suggested, it may indicate some deep-seated feeling with which at a later day we shall have to reckon, his weighty words that "we can have no security or any confidence in the feelings of sympathy of other nations, and however much we may honour them; however grateful we may be *for the sympathy they have shown us* (the italics are ours) we can have no security except in the efficacy of our defence and the strength

of our own right arm," must sink deeply into the minds of all thinking men of our blood and race and call forth the proper answer.

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It is thus then for us, as a nation, to see that the wave of opinion which has been so insidiously generating among the peoples of foreign nations against Great Britain, and which has risen to a size of somewhat disquieting proportions, has no chance of irresistibly breaking, or even of breaking at all, upon our shores.

It hardly seems necessary to advance the argument, except to give force to our remarks, that were once a blow effectively aimed at England by any foreign nation, it could not fail to be a calamity to civilisation at large, but this apparently does not enter into the calculations of our antagonists. With regard to the feeling voiced by partizans in the United States, we can hardly conceive that that is the concrete opinion of the great and intelligent American nation. It is merely necessary to remind our readers that the United States is our greatest trade competitor. Further than that on this point at the present we have nothing to add.

It has been aptly put that "the best way to avoid danger is to meet it plump," and we own to a feeling of the liveliest gratification at the apparently earnest endeavours at preparedness against all eventualities which the Government of this country are manifesting. We are, it is evident, beginning to sensibly realise our gigantic responsibilities, and in whatever schemes of imperial defence this country may undertake, we feel sure of the hearty and practical co-operation of our Colonies and Dependencies, who have done so much for us under the present trying circumstances. In the opportune and historical visit which the Australian Delegates are paying to our shores in connection with the Federation of our great possessions in the southern hemisphere, we are assured that a result will be consummated of permanent and untold benefit to the British race. The current of Imperial enthusiasm has been running higher year by year, and it has now reached a point when, if full advantage be taken of the opportunity, the corner stone can be laid for the protection of our possessions and our trade interests throughout the world, which should be the strongest possible guarantee for our continued progress and for the peace of mankind. The First Lord of the Admiralty's eloquent appeal to British manufacturers and "all who are able to assist" will not fall on barren ground, and in the committee of scientific men which the Government is appointing, they are taking a step which will be commended by all thinking men under the British flag.

American Competition.

AT various times the attention of our readers has been directed to the growth of manufacturing industries in the United States and to the enterprising methods adopted by American firms for the introduction of their goods, both into this country and into markets which in times past were essentially under British control. A series of

articles now running in *The Times* is devoted to the general subject of American Engineering Competition and several numbers have already appeared, dealing fully, though in a somewhat discursive manner, with statistics, ore supplies, transport, steel manufacture and structural work. One of our engineering contemporaries appears almost to resent this action on the part of *The Times* as if it constituted an unnecessary interference with technical literature, and the same journal suggests that whilst the British manufacturer is already able to realise the conditions which have to be faced, the general public is not likely to take much interest in matters of the kind. Our own view is that the subject of foreign competition ought to receive the utmost prominence and we think everyone who has the welfare of his country at heart should rejoice to find that information upon so important a matter is being reported in a popular journal. Perhaps the manner in which some of the statistics are presented may be open to criticism and the conclusions drawn may not be in every instance strictly justified, but the writer is perfectly correct in the general statements he makes as to the immense proportions already assumed by iron and steel industries in America, and in pointing to the fact that Great Britain no longer occupies the premier position, so far as output is concerned. A knowledge of this circumstance may not be pleasing to our national pride, but it should neither hurt our feelings nor be the cause of the slightest despondency. As a nation we cannot prevent the development of mineral wealth in other countries, nor should we desire so to do; for the prosperity of the British Empire is largely associated with the general prosperity of the world. Moreover, considerations as to relative production are of less intrinsic importance than the questions whether the resources of our own country are being advantageously utilised, and whether our industrial and mercantile organisation at home and abroad is in every way suited to the conditions prevailing in the present day. The articles to which we refer do not greatly assist the general reader in drawing a comparison between American methods which are applicable in Great Britain and those which are actually practised here. Consequently the articles are more likely to be interesting from a descriptive point of view than to conduce to reforms of industrial practice. Many things are possible in the United States which cannot be attempted here, owing to different physical and geographical conditions. Lake Superior ores are not only richer than ores used in this country, but they are generally easier to win; the Carnegie Steel Company of Pittsburg not only owns most extensive coke works, but a natural gas field of 206 square miles; the same Company has constructed a railway 135 miles long, in order to complete the chain of control from the mines to the works, and other firms have the benefit of cheap transport upon inland seas and a splendid system of canals. It is interesting to know these things, but no one will suggest that the British iron manufacturer can alter the depth at which mineral is to be found, or that he can import natural gas fields and plant them in the vicinity of his works. He might, perhaps, construct short railways in some instances, providing that permission could be readily obtained and the cost of land were not excessive. Similarly our canal system might be widely extended, if such waterways were directly encouraged by the State and protected from the railway despotism which now interferes with their proper use. It is the fact, unfortunately, that heavy expense is always involved before sanction for new means of transport can be obtained, and Parliamentary Committees frequently pay undue attention to objections raised on behalf of rival undertakings. One of the great needs of our land in the present day is

better provision for traffic of every kind, and it is incomprehensible that the legislature should continue to obstruct every effort made to improve facilities for commerce and convenience. With regard to the equipment of iron and steel works, *The Times* certainly does draw a marked distinction between American and British procedure. The great object of the former is to supersede manual labour by mechanical devices, and this desirable end is successfully achieved to a very considerable degree in the large establishments of the United States. Capital expenditure is not allowed to stand in the way, because it is known that an adequate return will inevitably be forthcoming. American workmen are said to be relieved from labour which is purely mechanical, and are expected to perform work of a higher order in which their intelligence may be exercised. All this is very praiseworthy, but what is the unfortunate British manufacturer to do when trade unionism is directly opposed to the employment of all labour-saving appliances and insists that the workman shall not be allowed to become an intelligent mechanic, doing his best for himself and his country, but shall and must continue to be an ignorant drudge, limiting his usefulness and reducing himself to the level of the least intelligent of his fellows? If some of the ultra-liberal writers and orators who are now trying to do so much harm to their country for purely party purposes, would direct their fulminations against the deadly conservatism of trade unionists they might be of more service to the State than they can possibly be to the political party to which they professedly belong. So far as engineering industries are concerned in this country, the proper employment of mechanical aids cannot be possible until workmen become more reasonable, or employers obtain greater power by more complete combination.

Leaving these considerations, we do not think our more important engineering establishments in other respects fall far short of the standard so much praised by the special correspondent of *The Times*. In Glasgow, Sheffield, Newcastle, Belfast and in other cities and towns, there are works which are generally believed to be capable of holding their own with any others in the world. There are, however, other works of smaller dimensions but still of sufficient importance, which might advantageously be remodelled, and in some cases no doubt amalgamations could be effected so that operations might be conducted on a larger and more favourable basis. Dealing with structural work, *The Times* speaks somewhat slightingly of the "Great George Street Engineer," who is supposed to be capable of producing more or less unworkable designs for bridges and railways, upon which the manufacturing engineer must tender and execute in some satisfactory manner by the aid of unnecessary expense and ingenuity. American Bridge and Steel Companies are accustomed to the design of the most important works, and, moreover, they make a point of publishing specifications which may confidently be accepted as they stand by consulting engineers or architects. No doubt this practice is of the utmost convenience and value, as theoretical principles can always be applied more satisfactorily by practical men who possess proper technical knowledge, than by those whose training has been purely theoretical. One reason why manufacturing firms are not so favourably treated in this country is perhaps to be found in their extraordinary reluctance to publish any information which can possibly be withheld, for fear that it shall be copied by their competitors. One has only to write to a few leading firms who manufacture iron and steel to find out how utterly unsatisfying are the details furnished by British makers. A very different policy prevails in the United States, and we firmly believe that it is

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a powerful factor of success. Up to the present, no mention has been made by *The Times* of the willingness evinced by the American manufacturer to adapt his ideas and patterns to the varying requirements of purchasers. Our own reluctance as a nation to do likewise is well-known, and instances are frequent where important business is lost because of our cast iron rigidity in this respect. Perhaps the present time of almost unparalleled prosperity is not one particularly favourable for the suggestion of reforms, for the engineer who is surfeited with work will be apt to say that this state of things is a sufficient answer to adverse criticism. Prosperity, however, is not always in the ascendant, and days are sure to come when those who have been wise in time will have reason to be thankful for their foresight. Apart from alternations of prosperity and depression there is always the probability that the present phenomenal home demands of the United States will diminish as the country is more fully supplied with purely constructural works. When the stage is reached that the enormous iron and steel works of America require fresh outlets for their productions, British manufacturers will experience more extensive and more trying competition, both at home and abroad, than has been evidenced in times past.

Municipal Trading.

THERE can be no doubt that this question is one of the burning problems of the moment, and that its solution is forced upon us by a novel situation which has developed almost unperceived by the general public, although it involves the abandoning of some of the most time-honoured traditions by which England has risen to the first place among the industrial nations of the world. Individual enterprise and energy lie at the very root of England's greatness, and it was by a process of the survival of the fittest, that British subjects obtained supremacy in their special spheres of action. Bureaucratic control and paternal government have been almost unknown in Great Britain until recently, and it was left to every unit of the population to find its own level. At present we are to a certain extent to abandon private enterprise, and to leave great commercial undertakings to the local authorities, who will take care of a portion of our money, invest it to their best ability and hand over to us a part of the profits, while with the other part they will make us as comfortable as possible. And in what kind of commerce is this money to be invested? The following is the startling list of undertakings proposed by British municipalities, to which Lord Avebury recently drew the attention of the London Chamber of Commerce. "Banking, pawnbroking, coal-supply, saddlery, telephones, tailoring, manufacture of electrical fittings and of the residual products of gas, supply of apparatus for games, Turkish baths, cold air stores, refrigerators, estate agency, printing, constructing lifts, etc." Such are the branches of industries in which some of our local bodies intend to invest the local rates, and in which they desire to engage with the leave of Parliament. They give various causes for this desire, differing with local circumstances, but nearly all of them claim to be prompted by the idea that they will succeed as well as, if not better than, private individuals or companies in making money in these lines of industry and commerce, and while the latter are using the money reaped for their own benefit, the local authorities intend to employ it for increasing the municipal funds and benefiting the community at large. But is this idea carried out in practice?

Fortunately men born and raised in England, and brought up under the influence of English standards of business morality, are not likely to become tainted by participating in a system of

municipal spoils such as characterises municipalism in the United States. Still, the corrupt practices of Tammany Hall in New York, the disgraceful robbery connected with the building of the City Hall in Philadelphia, which is still unfinished, though a self-perpetuating municipal commission has spent over it £4,000,000; the street-paving frauds in Chicago, and numberless similar cases should be a warning as to what may become of municipalism in the hands of unscrupulous men. It is, however, not so much corruption and dishonesty which is to be feared in the case of British local bodies, as incompetency arising from a lack of experience and special qualifications. It is true that in all cases of municipal enterprise, though the corporation will represent the owners, the management will be left to qualified engineers, or managers. Nobody will deny, however, that very great efficiency is not likely to result from an undertaking where the industrial knowledge and direction is confined to a paid employee, while those who are to exercise the general control have not the slightest knowledge or experience of the work they are controlling, and, in most cases, but a fraction of time to devote to such control. It will be very difficult, therefore, for them to obtain even approximately the same success as those who are both owners and managers of their business, or, at all events, possess abundant knowledge and experience to supervise and direct their managers.

Of course, there are some kinds of work which require greater special knowledge to undertake than others, and it is obvious that municipal enterprise is less apt to miscarry where such enterprise requires merely some kind of general grasp of the problem than where highly complicated technical knowledge is necessary. But that even as regards the former class of undertakings serious blunders may be committed, is demonstrated by the example furnished by the Shoreditch Corporation, with regard to the problem of housing the poor.

The question, therefore, how far municipal enterprise should be encouraged or limited is an extremely difficult one, and we believe that the time has not yet come to lay down any general principles regarding this subject. A Parliamentary committee may do a great deal of good in carefully investigating the many cases of municipal enterprise already existing in Great Britain at the present moment, and ascertaining how far such enterprise has really been of advantage to the ratepayers; it may do even more good in devising means for an honest and lucid auditing of corporation accounts, so as to lay correct data before the public at large; but, as regards general legislation, there exists no reliable basis for the moment, and Parliament will do well to deal with every case according to its merits. Whenever a municipality applies for extended powers, the onus of proofs of expediency should rest upon its shoulders, and where no such proof is forthcoming there is no reason to interfere with the time-honoured method of individual enterprise, which makes efficiency a necessary factor for obtaining success in the field of open competition.

Warfare and Invention.

It has often been said that the arms of a nation represent the highest mechanical skill and invention available in the country, and that its greatest of mechanicians are, as a rule, employed in devising and constructing implements of destruction. A nation's weapons are, therefore, regarded as an index of the mechanical progress of its people. Among the affairs of man there is, perhaps, nothing that calls forth so much thought and energy, or brings to the front so many real and would-be inventors as war.

At the time of the American rebellion it was said that Abraham Lincoln re-

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ceived hundreds of letters a day relating to supposed inventions, every one of which would completely annihilate the whole rebel army. When the rebel ram, *Merrimac*, came out of Hampton Roads, spreading destruction and devastation among the wooden ships of the Union fleet, the authorities are stated to have received upwards of thirty thousand letters, each containing plans for the sinking or destruction of the ship should she again attempt to come out. Indeed, so numerous and so ridiculous were the schemes for destroying ships and armies that the amateur inventor became the laughing-stock of the time.

At the time of the Venezuelan excitement it was reported that Mr. Edison proposed to annihilate the whole British fleet by a shower of electrically charged water. Doubtless Mr. Edison had never heard of the project until he saw it in the newspapers. Again, on the outbreak of the Spanish-American war, Tessler proposed to destroy the Spanish fleet by some kind of electrical discharge. Newspapers also announced that Mr. Hiram Maxim had offered his services to the United States Government, and offered to build a small cruiser, to arm it with big guns, one of which would completely annihilate the whole Spanish fleet at a distance of nine miles. Mr. Hiram Maxim, however, denied all knowledge of this remarkable project, and it was afterwards ascertained that it emanated from a totally different individual.

The present war in South Africa has not only demonstrated what sort of arms are the best adapted to modern warfare, but it has also brought forward numerous suggestions from both scientific and unscientific men, many of which are extremely interesting. Of the latter class, perhaps, the most notable is Mr. Isaac Maxim, who writes under the *nom de plume* of Hudson Maxim. In an article which appeared in the *Home Magazine*, an American publication, Mr. Isaac Maxim attempted to point out what the warfare of the future will be like. The article has several illustrations. One of them shows a species of planting machine, worked by a motor car. This machine is supposed to plant dynamite cartridges in the earth, and to explode them as it passes over the field. A rather important item, however, appears to have escaped the vigilance of the inventor, and that is the necessity for some appliance to prevent the whole concern, with the motor car and the driver, going off at the same time.

Another remarkable illustration shows a partially submarine boat for destroying battleships. Instead of using the ordinary steam-engine and boiler, with a coal fire, the inventor proposes to use as a fuel large sticks of smokeless powder, about one foot in diameter and one hundred feet in length. The whole bottom of the hull of the ship is to be filled with these sticks, which it is proposed to force into the furnaces, to combine the products of the combustion which results with the steam of the boiler, and to use the combined gases on a turbine, which Mr. Isaac Maxim calculates might drive the ship thirty miles an hour. He admits that the rate of burning of such a combustible compound may be increased by increasing the pressure. In other words, that the rate of burning increases as the pressure increases. Now, as any increase in the rate of burning must of necessity increase the pressure, the pressure must again react on the rate of burning, and the burning in its turn again react upon the pressure. Therefore action and reaction will follow each other in such rapid succession that, instead of the material requiring some hours to be consumed, as he supposed, according to his own showing it would probably all explode in the small fraction of one second; while at the same time the ship, with all it contained, would appear as fine dust in the air.

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"We are, in the vastness of our possessions, losing our grip on national sentiment. It is our duty to maintain intact, and to defend by sea and land, all that our empire builders have left us. The day that sees the defence of the British Empire sapped, sees the disintegration of the Nation's trade and the hands of civilization's timepiece put back 200 years."—RT. HON. LORD CHARLES BERESFORD, C.B.

To our Readers . . .

THIS issue completes the second volume of FEILDEN'S MAGAZINE, and inaugurates a new departure as far as our printing and publishing arrangements are concerned. It will be of interest to those thousands in the industrial world who have followed the rising fortunes of Great Britain's *only* REPRESENTATIVE Engineering monthly to know that we have made such arrangements as will, in future, ensure if possible an even better publication than we have hitherto produced. For some time past we have been making extensive and elaborate plans, involving, among other things, the purchase of some thousands of pounds' worth of the latest and best type and machinery, necessitated by the growth and popularity of FEILDEN'S MAGAZINE and its attendant organisation. This month sees the first of the issues turned out under the new auspices. It is but the forerunner of better things to come. Next month starts our third volume, and the number will present some novel and special features.

With the August issue, FEILDEN'S MAGAZINE will have reached its first anniversary, and to celebrate that event in a fitting manner it is intended to make that number the biggest and best of any technical periodical the world has yet seen. In this connection the cover of the magazine itself will be a perfect work of art, and the contents will be unique ; in fact the whole issue will be worthy the reputation FEILDEN'S MAGAZINE has acquired.

The Manchester and Liverpool Express Railway . . .

FOR some time past there has been an increasing demand for more rapid means of transit between Manchester and Liverpool, but the practical limit of speed upon ordinary railroads has already been attained. It is now proposed to make use of the single rail system invented by Mr. Behr, by the aid of which a speed of 110 miles an hour may safely be employed, thus reducing the duration of the journey to about 20 minutes. The construction of the Behr mono-rail system is exceedingly simple. A single rail is fixed on the top of steel trestle supports 4 ft. high, on which the car is supported and balanced, whilst guide rails are provided on the lower part of the trestles to take internal pressure when curves are being passed. The car is constructed with longitudinal seats placed back to back, and the rail occupies space between the two seats. Therefore a considerable proportion of the weight is below the line of support, and as the electric motors are also carried in the lower portion of the car, the centre of gravity is so low that derailment should be practically impossible. In the present example it is proposed that a central power station shall be established at Warrington, whence electricity will be carried along the line by conduits to transformers from which it will pass along the guide rails to the motors beneath the car. To provide for safety an automatic arrange-

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ment has been devised whereby the current will be temporarily cut off on the section of the line immediately behind that on which each car is travelling. The adoption of this system should render it impossible for the cars to overtake each other, and as there are to be no intermediate stations, management of the traffic will present none of the difficulties experienced on ordinary railways. Satisfactory trials of the Behr system have already been made in Ireland and in Belgium, and a committee of investigation appointed by the Liverpool Chamber of Commerce reported so favourably upon the matter that the present company has been formed with a capital of £2,000,000, to undertake the construction of the line. The only thing now wanted is the approval of Parliament. Of course there is opposition, but this is confined to three railway companies who dislike competition and to some local authorities who will receive no direct benefit and possibly desire that other people should have none. The corporation of Salford in particular, objects to the new line on æsthetic grounds, believing it will seriously disfigure the town, whose beauties are no doubt familiar to most of our readers. Expert evidence tendered before the Parliamentary Committee, under the presidency of Sir John Kennaway, is entirely favourable to the scheme, to which we wish every success.

The Progress of Tasmania . . .

THE island of Tasmania, though in size by far the smallest of the Australasian group, is one of the most interesting of the British Colonies. In its climate, scenery, fertility and its mineral deposits, Tasmania is so favoured that it might almost ascribe to itself the title of the "Fortunate Isle." In romantic natural beauty and inherent health combined, it probably surpasses any other British Colony in the Southern Pacific. Though embracing an area of some 26,000 square miles, its population relatively is small, being only about 150,000, which is very unequally distributed throughout the country.

It will come as a surprise to many people who believe the geographical possibilities of the world to be exhausted, to find that a considerable part of Tasmania is yet unexplored. A tolerably accurate survey, it is true, has been taken of the island generally, but a large portion of the country is so mountainous and so densely wooded as to be almost unaccessible. The scenery in these districts is full of grandeur: high mountains clothed with sub-tropic verdure, waterfalls, chasms, and swift rivers.

The progress of the island was greatly retarded by the discovery of gold in Victoria, which depleted it of half its population. But the discovery of the immense tin deposits in Mount Bischopp, followed by others of scarcely less importance, has more than restored Tasmania to its former position. It appears to be now certain that gold, silver, copper, tin, together with rich stores of what are called the "rare earths," zirconia, thurium, yttrium, lanthanium, and others more precious far than gold or platinum (pure zirconium metal is worth £76 an ounce), are to be found in these unexplored regions, and require only capital for their exploitation.

Tasmania has been neglected by the British capitalist, but there can be no doubt that the island in the near future will prove a market for home enterprise and home exports of no small magnitude.

The Huxley Memorial . . .

OF the great men of the Victorian era, few have contributed more to the intellectual revolution which has placed the study of the sciences and their applications in the first rank of modern education than the late Professor Hux-

ley, whose statue in the Natural History Museum of South Kensington was unveiled about a month ago. If any of our contemporaries might have been justified in applying the proud words of Horace to himself : *Exegi monumentum aere perennius*, it was certainly that great and independent thinker of whom the Duke of Devonshire justly remarked that his real memorial was to be found in his writings, and still more, in the moral influence which he exercised on the minds of younger men. Few of those born within the last quarter of a century can realise the stubborn resistance and hostility which formerly those had to meet in our country, who courageously insisted upon teaching the people at large the great truths of scientific research and maintaining the authority of science, even where it clashed with the cherished beliefs of an orthodoxy of which but few traces have survived until now. We, who enjoy the benefits of scientific research and its applications in almost every direction of our private and public life, are apt to forget the earnest and unswerving efforts that were needed, not so very long ago, to smooth the way for scientific progress, and such commemorations as that of April 28th, represent but a small portion of the gratitude we owe to such men as the great champion of science in whose honour it took place.

Pneumatic Canal Locks . . .

An ingenious device known as the Dutton pneumatic-balance canal lock, has been approved by the State Engineer, and adopted by the Canal Board of the State of New York, to replace five pairs of lift locks at Lockport, and two pairs of guard locks between the same place and Buffalo, whilst sixteen pairs, known as "the sixteens," are to be installed on the Erie Canal at Cohoes, in New York State. These locks float on compressed air confined in their lower chambers, and each lock carries a tank containing sufficient water for navigation, and gates of the usual kind are fitted at each end of the tanks. When one lock descends, the other ascends and during the operation air is expelled from the air-chamber of the descending lock into a similar receptacle of the ascending lock, through a connecting way controlled by a valve of suitable construction. No compressed air is discharged into the atmosphere or is otherwise wasted, and motive force is provided by increasing the depth of water in the descending lock. Considerable lifts are possible under this system ; for instance, at Cohoes the lift is 144 ft., at Lockport the normal lift is over 57 ft., and the extreme limit in time of flood is 62 ft. 5 ins. The effective length inside each tank is 310 ft., the width is 28 ft., and the average depth is 12 ft. The locks are built of steel, and only one minute is occupied in making the stroke. Allowing for time necessarily taken up by entry and exit, canal boats are enabled to pass through the locks with a delay of not more than ten minutes. This form of lock is one which renders possible a change in the essential conditions of canal construction. Hitherto it has been necessary to consider the means available for supplying the locks from the summit level, and for maintaining the water level within narrow limits. The large quantity of water and the currents necessary for locking have involved a constantly running supply, as well as overflows for escape when the locks were not in frequent use. Moreover, with small lifts, the choice of gentle slopes has always been a desideratum. By the adoption of pneumatic locks, the levels may be long, and the locks few in number ; waste of water can be avoided, and in cases where the descending tonnage is heavy, it will not only operate the lock, but will also lift water to the upper channel. The cost of the plant at Lockport wil. be $1,000,000, and at Cohoes $1,500,000.

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but the State authorities estimate that the saving of wages will more than cover the interest on the entire cost.

The Pacific Steamship Lines . . .

SINCE the United States took over the Philippines there has been a considerable increase in the introduction of United States manufactures to the islands. Manilla has long had all the advantages of civilised appliances, telephones, telegraphs, electric light, and all the latest improved methods of conducting their commercial affairs. But now these improvements are spreading into the country, and wealthy farmers are introducing these things into their houses as well as the latest improved implements on to their farms. In consequence of the increased trade there is the proposed United States cable for the East, and it is proposed also that they should have their own cable ships for laying and repairing the cable when it has been laid. A further indication of the new enterprising spirit of the States, is the proposed intention of starting two new lines of steamers from the Western coast to the Orient. At the present time three lines run out of San Francisco. These are : The Pacific Mail Steamship Company ; The Oriental and Occidental ; and a Japanese Company. These run under a common arranged scheme, so that one steamer leaves for Hong Kong and intermediate ports every week. In view of the increasing traffic, the Pacific Mail Steamship Company has placed orders for two very large steamers to be built. At present their four steamers have a tonnage each rather under 5,000 tons; the new vessels will be of 12,000 tons, 575 ft. in length, 40 ft. depth, and they will be fitted with quadruple engines of 18,000 i.h.p. Further north is the other United States North Pacific Railway line with its terminus at Seattle in the Puget Sound. A Japanese fleet of steamers at present run between Seattle and the East, but it is the intention of the directors of the North Pacific Railway Company to start a new fleet of steamers on the same line. By far the best line of steamers, however, which carry the mails and passengers across the Pacific is the Empress line, which sails from Vancouver, the Western terminus of the Canadian Pacific Railway. There are three steamers : the *Empress of India*, *Empress of Japan*, and *Empress of China*, each of 6,000 tons, 485 ft. long, and of 10,000 i.h.p. They have made 19 knots, and when tried, the journey between Liverpool and Yokohama was done in twenty-one days. The steamers are twin screw and steam between Vancouver and Yokohama in 10½ days. There is a second line of steamers, each 357 ft. long, 3,500 tons, which develop 17 knots on the line between Vancouver and Australia. But though great increase of shipping and ship yards are reported along the United States sea board, we do not hear of any similar increase on the coast of our colony.

The Traffic of Great Cities . . .

LAST month we made some reference to the measures which are in progress for facilitating rapid transit in the city of New York. It is not the practice of Americans to leave matters of this kind to chance as we generally do, at any rate in London. On the contrary, as soon as the necessity for improvement becomes evident, the responsible authorities usually take prompt steps with the object of securing the appointment of a special commission armed by Legislature with plenary powers, so that the question may be dealt with in a thorough and comprehensive fashion. A commission of this kind has been in existence for about four years in the city of Boston, and by act of the Legislature last year, its term of office was extended for a further period of three years. The

scope of the Boston Transit Commission includes the construction of a subway having three tracks for electric cars; the abolition of certain tram lines in the streets; the establishment of connections between the subway and the Boston Elevated Railway; the construction of a tunnel, connecting the city proper with East Boston; and the building at Charlestown, of a new bridge with a draw-span. When finally completed these works will probably represent an expenditure not far short of $12,000,000. Part of the subway is now open to traffic, and the surface lines previously mentioned have been removed. In Tremont Street, when all the car traffic ran on the surface, the utmost limit of capacity was 200 cars per hour each way, and the cars moved at the funereal pace of about two miles an hour, and the mournful procession was interspersed by frequent blockages. One month after the complete transfer of traffic to the subway, the number of cars passing freely each way in times of greatest pressure was 282 per hour, the rate of speed being between seven and eight miles an hour. During the first eleven months of working the use of the subway was at the rate of at least 50,000,000 passengers a year. The Boston Elevated Railway, and the Lynn and Boston Railway, together operate over 400 miles of line, and in the year 1897 to 1898, carried about 200,000,000 passengers. Out of this total it is estimated that one of every four passengers passes through some portion of the new subway. At Park Street Station, which is used as a general junction between the Subway and the Elevated Railway, the number of passengers has been at the rate of 27,400,000 a year, or about 400,000 more than the number of persons passing through Broad Street Station, London. This experience clearly points to the desirability of transferring certain classes of traffic from the surface to subways. Fortunately, London is now beginning to move actively in the matter of additional facilities for locomotion. Private enterprise has to be thanked for existing and projected subways, and for proposals to extend and improve suburban tramway services, and the County Council also deserve every credit for its efforts in a similar direction. It should not be forgotten, however, that much more extensive developments will be necessary before the condition of London can be perceptibly ameliorated. Several subways from north to south are urgently wanted, as well as others from east to west, and the possibilities of the Thames as a great highway should be developed by some public body, more capable than the Thames Conservancy of appreciating the realities of life. When such facilities as these exist, it might then, perhaps, be possible to pass an Act of Parliament for the purpose of stamping out the plague of omnibuses which now infests every main thoroughfare of the metropolis. These hideous structures are only to be tolerated because the resources of civilisation have hitherto been so sparingly applied to the problem of street traffic.

Proposed Ministry of Commerce and Industry in the United States . . .

It is not to be wondered at that the inhabitants of the United States are recognising the expediency of establishing a government department to deal with their industry and trade, that are increasing in an amazing manner. It is true that, so far, the absence of a special ministry for these purposes has not been greatly felt, as the various other departments have divided the duties of regulating commerce and industry among themselves; but their work is becoming too heavy, and, especially since the United States have abandoned their policy of seclusion, and decided to take a share in the international life of the world, a Government Department carefully watching

over the commercial and industrial interest of the country will be of great utility. Two Bills, with the object of creating such a department, have been introduced, one in the House and the other in the Senate. It is stated that the latter is the most likely to be adopted. This Bill provides for a Cabinet officer and an assistant secretary, who will be charged with the regulation of the foreign and internal commerce of the country—excepting matters of revenue and collection of customs—with the supervision of the transportation facilities within certain limits, the mining industries, the fishing, manufactures, patents and trade marks, and other similar matters ; but, of course, the whole question will be fully debated before the duties of the new Department are definitely decided upon.

The Trade Unions at their Game in the United States . . .

UNTIL recently the industries in the United States have been comparatively unhampered by the tyrannical interference of the trade unions, such as we have been accustomed to in this country. But it seems that the turn of our American cousins is now coming, and that they will have to pass through experiences similar to our own. According to the *Iron Age*, a strike of engineers' machinists, which is likely to assume large dimensions, has begun in Chicago, in consequence of the refusal of the employers to meet certain demands of the men. Amongst these we find the following: A fixed minimum wage, irrespective of earning capacity ; the employment of no other but union men ; the granting of walking delegates, whoever the persons so described may be, "the freedom of the shops, to take and settle grievances" ; restriction of the number of apprentices ; and re-engagement of workmen who have been discharged, before the employer can put new men to work, unless the walking delegate or representative of the union agrees that the workman was discharged for a good cause ; the union to be the sole judge of what constitutes good cause. It is no wonder that the American employers of labour have resolved to stand firm against these preposterous demands, but if the struggle should be as protracted as it has been in this country, the iron and steel industry of the United States will receive a severe shock, and there will be, for some time at least, a pause in its remarkable progress.

Agricultural Machinery for Germany . . .

OUR manufacturers of agricultural implements will have an increasing opportunity in the near future for exporting a good number of their articles into Germany. German agriculture is reviving and the great landed proprietors, as well as many of the larger farmers, evince a desire to profit, in the cultivation of their lands, through the larger facilities now offered by appropriate mechanical devices. This desire is increased by the fact that there is a real scarcity of agricultural labourers, since most of the young men raised on farms, after having completed their military service, have lost their taste for farming work and crowd into the large cities in order to find more congenial employment. For these reasons especially the Rhenish and Westphalian farmers are anxious to secure for their work labour-saving machinery, and we are glad to hear that an effort is being made to form at Cologne a Trading Company for the exhibition and sale of agricultural implements of English and American manufacture. Such an exhibition will prove far more effective in obtaining customers than the most elaborate and most profusely illustrated description in a trade catalogue. All information regarding the profit will be willingly furnished by Mr. C. A. Niessen,

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the British Consul, or by Mr. Charles E. Barnes, the American Consul, at Cologne.

Corrosion of Screw Shafts . . .

THE paper read before the last meeting of the Naval Architects on the Corrosion of Screw Shafts brought out as many theories to explain it as there were speakers. The principal and the most pleasing to listen to, because they excited wonder, were those which involved molecular actions. Molecular actions are very popular just now. Whenever there is any difficulty, whenever two or three inquirers meet together on any engineering problem and there are differences of opinion, it is quite certain that molecular action will finally be blamed for any trouble. It is interesting to see how molecular actions lend themselves to mathematical manipulation. And when demonstrators get that length they are quite safe, for it will be some trouble and little profit to prove them wrong. But it appears to us that Mr. Alexander Dalrymple, in a letter in *The Engineer*, has scored against some of the theories advanced to explain the corrosion of shafts, even though these theories were backed up with lucid diagrams and incontrovertible mathematics. One of the theories advanced is that at the termination of the liner on the shaft there is a bending action going on, and just at that point, due to the wearing of the particles against one another, a waste goes on at the surface and soon an indentation. This hollow place, which, is formed all round the shaft near the end of the liner, is due to bending. One theorist goes further, and says that if there is a mere change of diameter there will be a wasting rubbing parallel to the shaft as well as at right angles to it, and the same effect is produced. Of course the theory is clothed in technical phrases and wonderfully supported with mathematical equations. Mr. Dalrymple gives the case of a brass liner fixed bare on the shaft. A hollow place is worked all round the meeting place of liner and shaft. Theorists say it is due to bending. Another case is given, same liner, same shaft, only an indiarubber band is placed half over liner and half over shaft. To keep it in its place copper wire is wound over the band. Result : a hollow place at meeting place of rubber band and shaft and no injury to meeting place of liner and shaft. Clearly indiarubber band did not strengthen shaft against bending, and former hollow was not due to bending. Mr. Dalrymple says that the action was galvanic first between liner and shaft, and second between copper wire and shaft. To prove this the rubber band was placed between a brass liner and an iron band shrunk on, so that the place on the shaft where galvanic action could take place was covered by rubber. After three years this was hauled off and no corrosion was visible. Mr. Dalrymple appears to think that the bending diagrams are of little use, and the mathematical and molecular theories a delusion, and if the cases he has given are reliable we agree with him.

Electricity in the Service of Agriculture . . .

OUR manufacturers of electrical generators and apparatus will do well to watch an experiment that is being tried at present in Germany. An association of farmers in Bavaria are building large electrical works to supply power for agricultural uses. The current is generated near the village of Schaftersheim, a distance of seven miles from the district of consumption, and is supplied partly by steam and partly by water power. From there it is to be sent at a pressure of 5,000 volts to the surrounding villages, where it will be employed for driving threshing machines, chaff cutters, bruising mills, &c. The motors used are very simple and compact, so that

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they can easily be handled by farm hands. If this experiment should prove successful, it is almost certain to be imitated in other portions of Germany, as the power used, according to the estimates, is far more economical than horse-power or steam power in separate plants; and there might be a very profitable market for such installations also in our own country.

The Plumber's Latest Claim . . .

In the ordinary way, a claim from the plumber takes the form of a large bill for a comparatively small amount of work, which may have been executed in a manner satisfactory to the employer of this indispensable though not altogether popular tradesman. We now have to mention a claim of an entirely different kind, and one by no means calculated to add to the favour with which the plumber is generally regarded. Originally the plumber was a mechanic whose special function it was to deal with leaden materials, largely in the manufactured form of water pipes. In the present day, he employs other metals and materials, and in addition to being a plumber, he is frequently a combination of painter, decorator, bell-hanger, gas-fitter, hot water fitter, and "sanitary engineer." In this multiform capacity he is looked upon as a sort of factotum who can properly be asked to undertake any kind of work about a house which does not appear to appertain to any other individual tradesman. Therefore the plumber should be in every way a thoroughly contented man, if such a condition were possible in our degenerate world. That he is by no means contented is evidenced by a movement recently started in Leicester by the Plumbers' Union, and by isolated attempts of the same kind in the Metropolis. Briefly expressed, the claim to which we refer lays down the doctrine that the mission of a plumber includes the provision and fitting of all pipes conveying either cold or hot water for domestic and industrial purposes, whether the pipe be of iron or of lead. Hitherto, engineers have been in the habit of performing work of this kind, sometimes for water services pure and simple, and at others in connection with apparatus requiring or furnishing such supplies. The plumber now comes forward with the novel theory that no engineer ought to be allowed to fit any cold or hot water pipes, though apparently he will for the present be graciously permitted to fit steam pipes. From every point of view it is to be hoped that engineering firms will unite in opposing a retrograde step of this kind, which emanates very inappropriately from a class already encroaching so considerably upon the preserves of other industries.

Germany's Shipbuilding Industry . . .

There can be no doubt that in Germany we have a serious rival as far as our shipbuilding trade is concerned; still, according to a statement made before the Budget Committee of the Reichstag, our own war-ships are still 20 per cent. cheaper than similar ships built in Germany. In order to protect German manufactures from loss through the importation of our cheaper shipbuilding materials, a proposal has been recently adopted by the Budget Committee of the Reichstag, prohibiting such importation from abroad without the payment of custom dues. We may be sure, however, that our rivals will continue to order the best and newest types of our auxiliary machinery for the purpose of studying and copying them.

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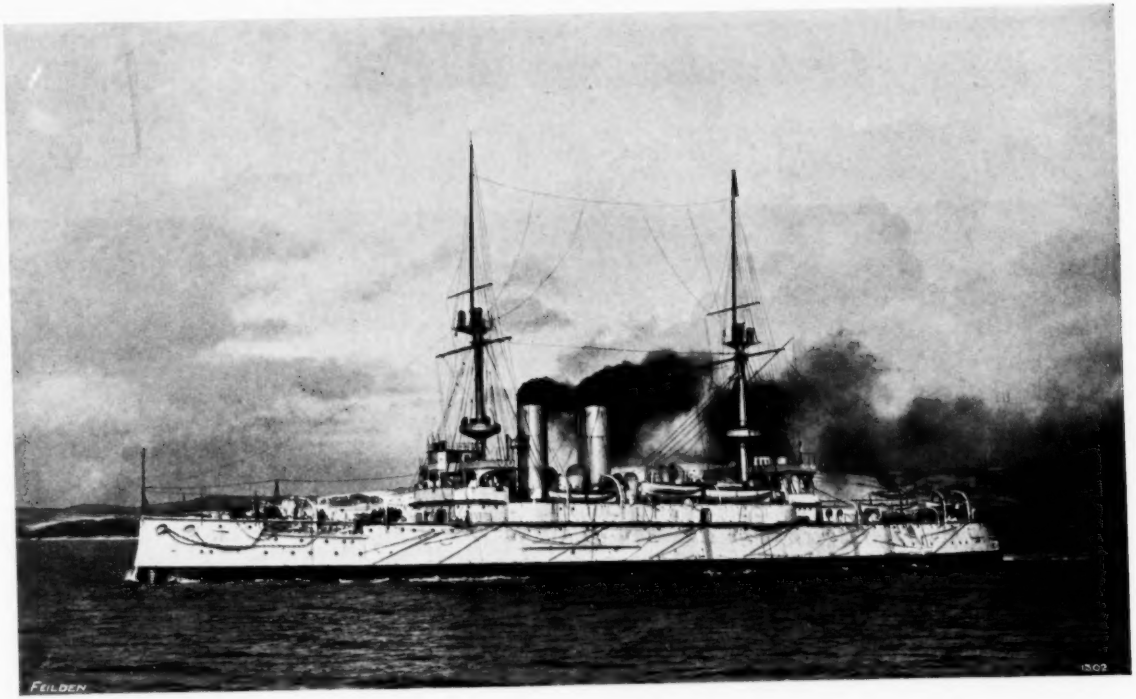
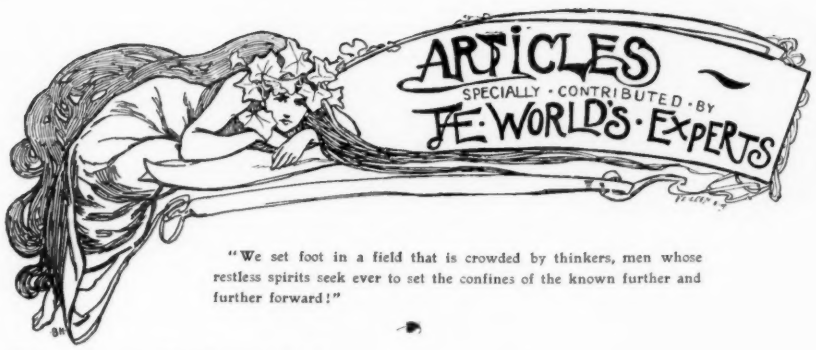


THE JAPANESE BATTLESHIP "ASAHI."
Built by MESSRS. JOHN BROWN & CO., LTD., *Clydebank.*



"We set foot in a field that is crowded by thinkers, men whose restless spirits seek ever to set the confines of the known further and further forward!"

Electro-Galvanising.

By SHERARD COWPER-COLES, M.I.E.E., A.M.I.C.E., &c.*

ELECTRO-GALVANISING has of late years made great progress, and is now being largely used in many shipbuilding yards for the electro-zincing of boiler-tubes, such as those used in the Normand, Thornycroft, and Belleville boilers. It is also employed for the coating of plates and angle-irons of torpedo-boat destroyers. The process was brought into practical use by the writer about five years ago, and since that time great improvements have been made in the method of handling the work, and in the working of the process.

To such an extent is the evil of the corrodibility of steel felt that some engineers still object to its use, or specify that a large portion of the work, such as the upper deck floors, &c., is to be of iron. In the face of these facts the question of an effective protective covering for steel becomes of supreme importance.

What then is the effective protective coating for iron and steel? At present the answer is, decidedly, zinc; in the near future we may expect to see aluminium coatings superseding those of zinc, although experiments in this direction have not yet met with success.

Sea air, charged as it is with brine, is more destructive in its action upon galvanised iron work than the air on land, as it forms a chloride which is readily soluble.

Zinc is much affected by all acids, organic and inorganic; hence zinc does not afford much protection to iron when in contact with oak. Soot forms a galvanic couple with zinc in the presence of acid and water. The action of water containing lime salts on zinc is very much the same as that of moist air, the metal becoming coated with a protective covering of mixed oxide and carbonate. Hot galvanising is often condemned as reducing the tensile strength of iron and steel, when the fault really lies with the smith who sends the work to be galvanised when he has made a bad weld, instead of leaving it in the black for inspection.

But still, as has already been pointed out, zinc forms the most effective coating for iron at present in practical use, and I will now briefly touch on the nature of the protection that it affords. Iron coated with zinc surfaces, after a short exposure, becomes covered with a thin

*A portrait and biography of Mr. Cowper-Coles appeared on p. 61, vol. i.

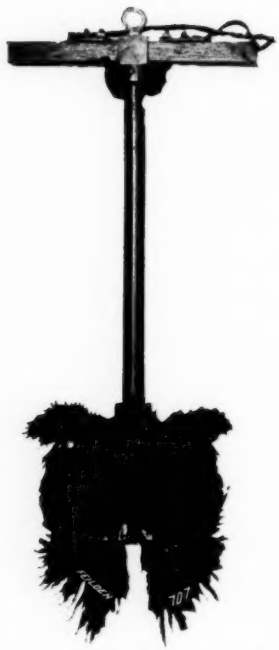


FIG 1.—MAGNETIC SCALE COLLECTOR.

film of oxide, which gradually passes into a basic carbonate and adheres tenaciously, forming a protective covering to the zinc. So long, therefore, as the zinc surface remains intact the underlying iron is effectively protected from corrosive action. The nature of the protective influence of zinc on the iron is galvanic zinc being electro-positive to iron.

Two metals in contact in the presence of moisture form a galvanic couple, and the result of the galvanic action set up under these conditions is analagous to that which takes place in a galvanic battery, namely, the electro-negative element remains unaffected so long as the action continues, the intensity of the chemical action being governed by the relative positions of the two metals in the electro-chemical series.

This electro-chemical action is sometimes curiously shown in fagotted iron bars. After lying about for some time the bars may be found to be rusted, not uniformly, but in parallel streaks running lengthways of the rod, these streaks giving the rod the appearance of having been built up of a number of parallel plates. This is evidence that the rod was originally made from fagotted iron, and the difference in electro-chemical condition of the alternate layers has

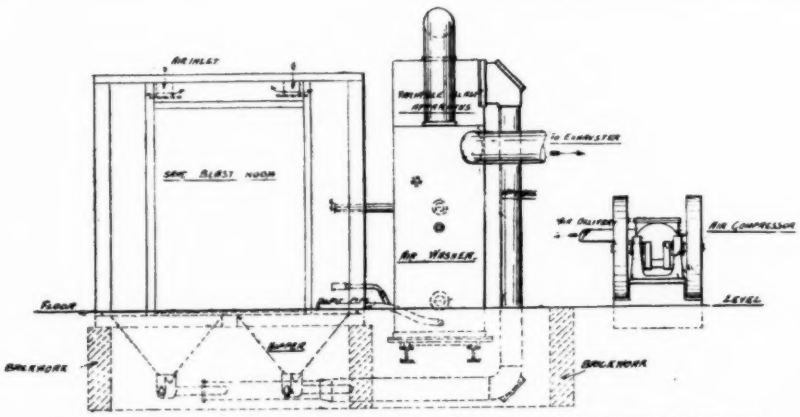


FIG 2.—ELEVATION OF A COMPLETE SAND-BLAST PLANT SUITABLE FOR CLEANING CASTINGS, PLATES, ETC.

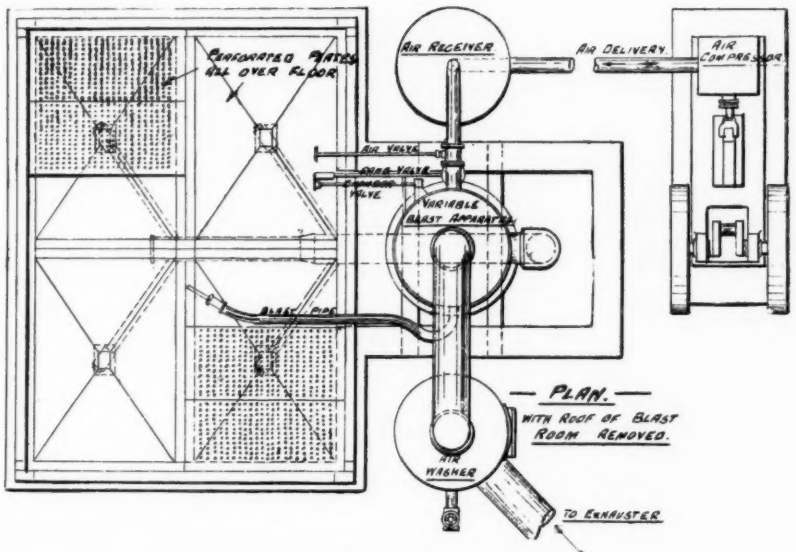
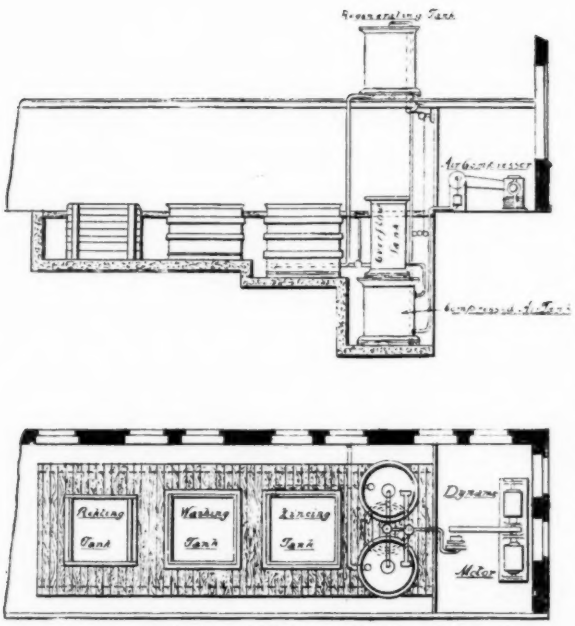


FIG 3.—PLAN OF A COMPLETE SAND-BLAST PLANT.

given rise to the oxidation only of the alternate positive layers. Tin and iron, and copper and iron, standing some distance apart in the series, give rise to a decided galvanic action, in which the iron, as the electro-positive metal, is corroded more rapidly if the coating is partly removed than it would be if not coated at all. For this reason copper sheathing, which was first used for vessels of the English Navy about the year 1770, is now insulated from the iron or steel hull by wood casing. This practice, no doubt, led to the strange blunder of H.M.S. *Audacious* being cased in wood, to which insulated zinc sheets were fastened, thus rendering the zinc quite worthless as a protection to the iron. With zinc and iron the positions of copper and iron, and tin and iron, are reversed. Zinc is positive to iron, and, consequently, whatever galvanic action is set up by their contact in the presence of moisture or other excitants must have for effect the solution or corrosion of the zinc and protection of the iron. At the present time galvanising has assumed the proportions of a very large industry, and is rapidly increasing now that steel of small section is being extensively used for constructional purposes. As compared with tinning, however, galvanising is a comparatively new industry, having been worked in Europe during the early part of the present century, and introduced into the United States from England. Messrs. Morewood and Rogers appear to have been the first to produce commercially galvanised corrugated sheets. In December 1846 they took out a patent for immersing articles in a bath of molten zinc, or an alloy of lead, zinc and tin, or zinc iron alloy, the surface of the molten metal being covered with sal-ammoniac or chloride of manganese. To equalise the coating they employed rollers, revolving in a flux kept at a lower temperature than the melting point of the coating metal.



FIGS. 4 AND 5.—SHEWING GENERAL ARRANGEMENT OF TANKS AND CIRCULATING SYSTEMS.

The chief improvements effected in hot galvanising since its introduction, have been in the construction and arrangements of the baths, and in the mechanical appliances for reducing the weight of spelter to the superficial foot. Rolled plates thus produced are not considered to be as good as flux plates, which have an average thickness of zinc of two ounces to the superficial square foot. Messrs. Davis & Sons, of Wolverhampton, have introduced a system of wet rolling the plates after annealing and pickling, the advantages claimed being a more uniform coating of zinc with a smaller consumption of spelter.

The Electro-zinced articles have no spangles, which has created considerable prejudice against such articles in certain foreign markets, when compared with the brilliancy and glitter of the spangles obtained by the hot process. The smooth surface of electro-deposited zinc can, by the adjustment of the current, be converted into a mat surface, which has been found especially suitable for the coating of nails, as it increases the holding properties, whilst on the other hand hot galvanising decreases the holding power.

The process of electro-galvanising consists in first of all removing any grease that may be present on the iron, and then removing the oxide or scale, either by immersing it in an acid solution or by sand-blasting. If the scale is removed by acid, the ironwork is placed in a solution of lime-water to neutralise any acid remaining in the pores of the iron. It is then placed in a third bath containing a solution of zinc sulphate, and an electric current passed through the solution so as to precipitate the zinc upon the ironwork, or cathode; the current is conducted into the solution through lead or zinc plates, the anodes.

The pickling solution most commonly employed is one containing one per cent. of commercial sulphuric acid. The Admiralty specify that all steel steam pipes, boiler and collector tubes, and all plates for boilers shall be pickled in a liquid consisting of 19 parts of water and one of hydrochloric acid, until the black oxide and scale formed during the process of manufacture is removed. The plates should be placed in the bath on edge and not laid flat. When taken out of this dilute acid all the surfaces have to be well brushed

and washed to clean off the loose scale, and then put in a bath filled and kept well supplied with fresh water or by thoroughly washing with a hose.

The writer has found that a considerable saving in acid can be effected by using a magnetic scale collector, Fig. 1, which consists of an electro-magnet with consequent poles, this method of connecting up having been adopted with the object of distributing the field as much as possible. The electro-magnet is encased in a copper shell, to prevent the sulphuric acid attacking the electro-magnets. The apparatus is placed in any convenient position in the tank, and connected by means of terminals to a depositing or electric-lighting dynamo, the current required to work it being 10 ampères when an E.M.F. of 6 volts is employed. In the case of large pickling tanks, two or more scale collectors can be used, or only one, which may be moved about to different parts of the bath at suitable intervals. From time to time the scale collector is taken out, and the adhering scale removed, either by breaking the circuit or by means of a suitable brush or scraper.

Sand-blasting is often used instead of pickling, and for many purposes it is found to give better results, especially for cast-iron work, from which it is very difficult to remove the last traces of acid. The sand blast process consists of projecting sand or other suitable abrasive material by means of air, at a pressure of about 10 lbs. to the square inch, on to the surface to be cleaned. The sand is projected on to the work to be cleaned through soft rubber tubes fitted with cast steel nozzles. The nozzles are soon cut through, but are quickly renewed at a small cost, the soft rubber tubing lasting for a considerable time. The cost of sand-blasting per square foot,

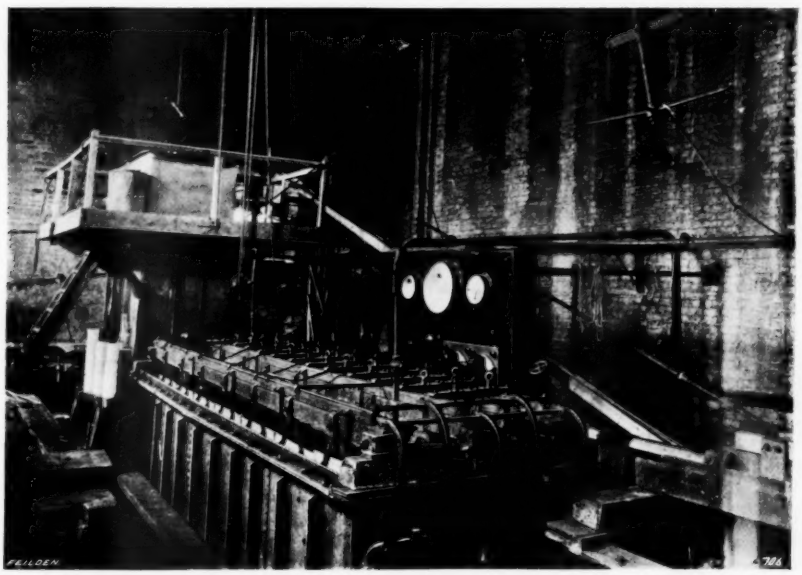


FIG. 6.—ELECTRO-GALVANISING PLANT AT MESSRS. MAUDSLAY, SONS AND FIELD'S BOILER WORKS.

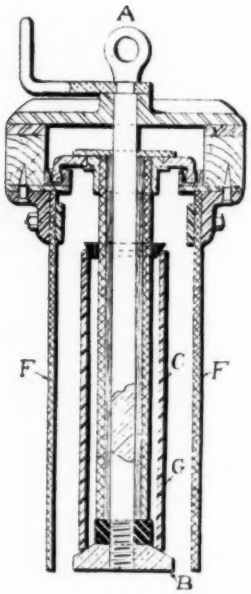


FIG. 7.

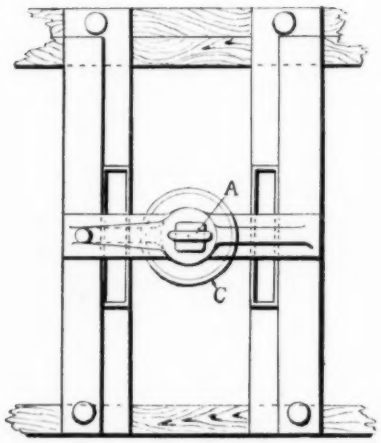
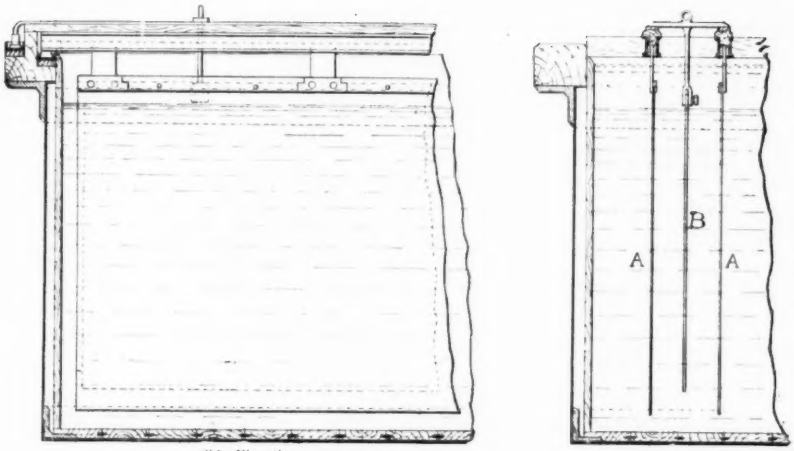


FIG. 8.

THESE ILLUSTRATIONS SHEW THE METHOD ADOPTED FOR ZINCING TUBES INSIDE AND OUT.

under the most favourable conditions, including the cost of labour, sand and power, is one-tenth of a penny, but the actual cost varies considerably with the nature of the work. When using quartz sand of the best quality, the loss is about 10 per cent. each time it is passed through the machine; the loss when using chilled iron sand is very small, the waste of the material replacing more than nine-tenths of the apparent loss. Figs. 2 and 3 show a complete sand-blast equipment suitable for cleaning castings, plates, &c. When heavy plates have to be sand-blasted, they are caused to travel slowly through the sand-blast room, whilst two jets of sand, propelled by air at a pressure of 10 lbs. per sq. in., are directed over its surface by workmen. The sand or chilled shot, after it has done its work, passes through an open floor-grating, and is caught in the hopper beneath, and at intervals allowed to return to the mixing chamber, the valves of which are regulated by levers in the sand-blast room.

When electro-galvanising was first introduced on a commercial scale, one of the chief difficulties encountered was the keeping of the solution from which the zinc is deposited in working order. This difficulty was eventually overcome in the following manner. The solution from which the zinc is deposited, which usually contains about 40 ozs. of zinc sulphate to the gallon of water, is circulated through the zincing tank by means of a centrifugal pump, or preferably by compressed air, the circulation being effected in the following manner. The solution which contains most free acid, and which rises to the top, is allowed to flow over a sill or division in the corner of the tank, into an overflow tank, from which it flows into a compressed air tank, into which air is blown and the solution forced into the regenerating tanks. A non-return valve is placed in the pipe connecting the overflow tank with the compressed air tank. The supply of



Side Elevation. Sectional End Elevation.

FIGS. 9 AND 10.—SHEWING THE ARRANGEMENT FOR THE ANODE.

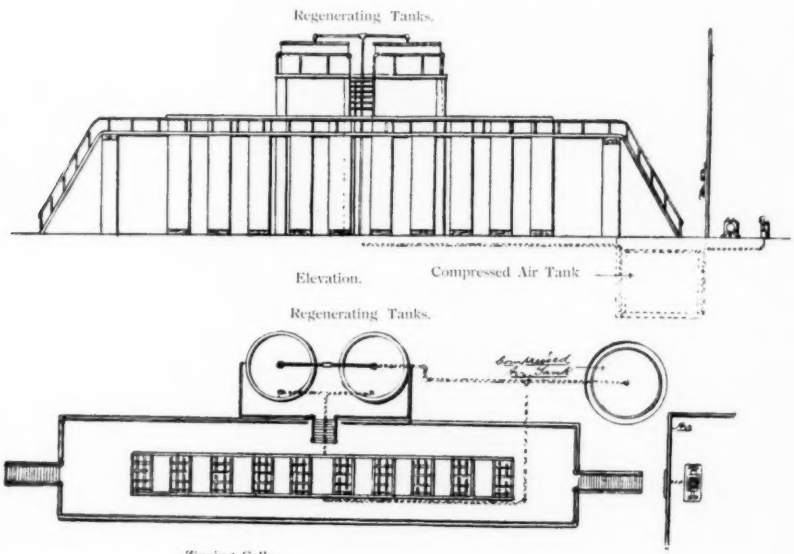


FIG. 11.—DETAILS OF PLANT FOR COATING BOILER TUBES IN LARGE QUANTITIES.

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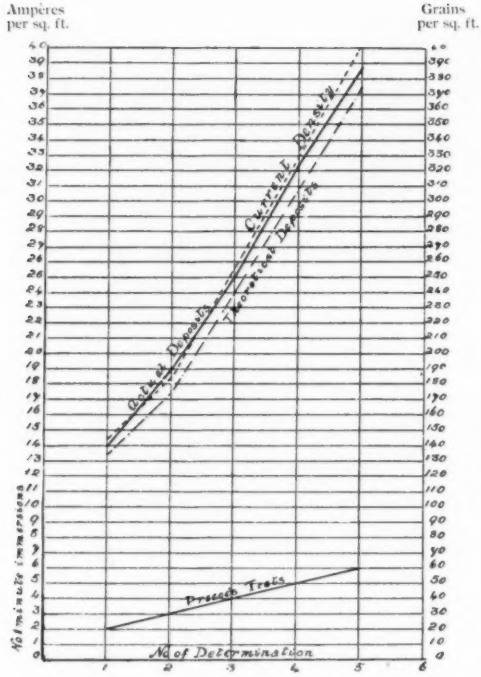


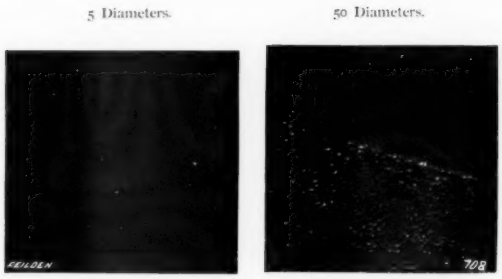
FIG. 12.—DIAGRAM SHEWING THE ACTUAL AND THEORETICAL DEPOSITS OBTAINED FROM A ZINC SULPHATE SOLUTION.

air to the compressed air tank is regulated by means of a three-way cock, actuated by a float placed in the regenerating tank in such a manner that when the air is cut off from the compressed air tank it is blown through the solution into the zincing tank, thus keeping it agitated; the solution returns to the zincing tank at the bottom opposite corner to which it leaves. The general arrangement of the various tanks and circulating systems are shown in Figs. 4 and 5. In the regenerating tanks are fixed wooden grids covered with matting, upon which layers of finely crushed coke and zinc dust are placed. As the solution which has been robbed of its zinc in the zincing bath percolates through the filter bed, the free acid it contains dissolves the zinc and forms fresh zinc sulphate, thus forming a continuous or cyclic process. It has been found by experiment that a zinc sulphate solution containing 12·59 per cent. of acid, after passing through a filter bed containing 10 per cent. of zinc dust, retained only 6·83 per cent. of free sulphuric acid. The zinc dust or tultz is a greyish amorphous substance (and must not be confused with zinc oxide), and is a by-product obtained in zinc distillation furnaces.

In practice it is found very important to keep the electrolyte slightly acid, as if it is neutral the zinc will not be adherent and will have a tendency to blister. The best proportion is about one-tenth of an ounce of free acid to every gallon of solution. The amount of free acid in the solution is quickly determined by dissolving capsules of gelatine or other suitable material which is readily soluble, containing a known weight of carbonate of soda in a measured quantity of the solution. A small quantity of lacmoid solution is then added, and if a pink colour is obtained it indicates the presence of more than ·10 ounce per gallon of free acid; if a violet colour is obtained the solution contains less than ·10 ounce per gallon free acid, and is in good working order.

Fig. 6 shows an electro-galvanising plant, erected at the works of Messrs. Maudslay, Sons & Field, Ld., which has been specially designed for the coating of Belleville boiler tubes inside and out. In the centre can be seen the regenerating tank with a platform near the top, which is used when recharging the filter bed.

Figs. 7 and 8 show the method that has been adopted for zincing tubes inside and out, the usual thickness of zinc



FIGS. 13 AND 14.—MICRO-PHOTOGRAPHS OF HOT-GALVANISING.

any surface. It is found in practice that one grain per square inch, which is equal to ·329 oz. per square foot, will withstand one immersion of one minute's duration in a saturated solution of copper sulphate at 60° F.

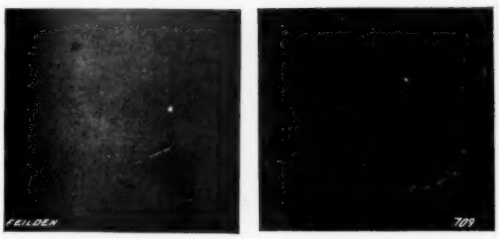
Figs. 13 and 14 show micro-photographs of hot galvanising. The line in the centre of Fig. 14 shows the line of demarcation between

being about 1¼ oz. per square foot. The tubes, during the process of zincing, are occasionally given a quarter or half turn by means of the handle, *A*, shown on the top of the suspension bar. When the tube is placed in position, the nut, *B*, is removed to allow of the tube being placed over the internal anode, *C*, the external anode being marked *F* and the tube to be zinced *G*.

Figs. 9 and 10 show the usual arrangement for the anode, the advantage of such a system being that the anode can be brought much nearer to the cathode than is usually the case, thus reducing the E.M.F. required.

Fig. 11 shows a plant that has been specially designed for coating Belleville boiler tubes for the Belleville Boiler Co. of St. Denis, in large quantities, the electro-galvanising baths being worked in series and the tubes in the baths in parallel.

Fig. 12 gives a diagram showing the actual and theoretical deposits obtained from a zinc sulphate solution with various current densities, the actual weight obtained being very near that of the theoretical. At the foot of the diagram is shown the result of Preece's, or the copper sulphate test for determining the thicknesses of zinc deposited on



FIGS. 15 AND 16.—MICRO-PHOTOGRAPHS SHOWING ELECTRO-DEPOSITED ZINC THROWN DOWN FROM A SOLUTION OF ZINC SULPHATE.

the crystals or spangles.

Figs. 15 and 16 show electro-deposited zinc thrown down from a solution of zinc sulphate with a current density of about 10 ampères per square foot, the zinc being so adhesive that it would not part from the plate even when the plate was broken.

Zinc Flashing is distinctive from electro zincing or cold galvanising, inasmuch as, in the first case, the zinc coating consists only of a few dwts. of zinc per square foot, in the second case of one or two ozs. or more for equal area; the former corresponding to a priming or intermediate coating for painting upon, the latter being an unprotected metallic coating. The extra durability obtained by thoroughly freeing the surface to be painted from all scale and oxide is considerable.

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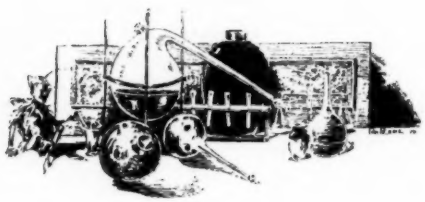
Iron work after pickling, even when well washed and dried, is quickly coated with a film of oxide which reduces the adhesion of the paint, and causes electro chemical action and the consequent flaking of the paint. A perfectly clean surface can be retained for painting upon, until such time as the paint can be applied, by giving the work a thin coating of zinc directly after pickling. Zinc Flashing has been found very useful for the preservation of steel work during transport.



The Evolution of the Portable Engine.

By WILLIAM FLETCHER, M.I.MECH.E.

WILLIAM FLETCHER served his apprenticeship with the largest engineering firm in Lincolnshire, after which he acted as leading draughtsman and assistant manager on smaller works in the South of England, and then as manager on important works in Norfolk. Following that he was eight years as chief draughtsman for Messrs. Marshall, Sons and Co. During later years he has devoted most of his time to the design and construction of Road Locomotives and their accessories, acting in that capacity for Messrs. Ransomes, Sims and Jefferies and now for Messrs. Clayton and Shuttleworth.

He has contributed numerous articles to many of the leading English and American publications, and has written some seventy articles to various journals on Steam Locomotion alone. A book on the subject is the standard work and has been repeatedly quoted by lecturers and writers on steam motor cars. The work was issued is 1891, when motor cars and steam carriages were occupying little or no attention. Soon after the publication some interest was created in motor carriages, and the manufacture of these vehicles now occupies a place among the world's industries. A second edition of a work on Steam Jacketing has recently been published.

THE unassuming portable engine is one of the most valuable drudges that science has ever devised for the good of mankind. No other engine can be placed to such a variety of purposes, and no other engine can perform those duties more efficiently. There are myriads of portable engines which are subjected to rough treatment by farmers' men, contractors' labourers, and others. In such cases the boilers are supplied with the dirtiest feed water, and are rarely cleaned out. The engines are exposed to all sorts of weather, the lubrication is neglected, no care is exercised to maintain the details in proper working order, the knocking of brasses for want of adjustment, and the leakage of steam from broken joints are allowed to work mischief without hindrance. In spite of this rough usage the engines continue to perform their work with regularity and ease. Some portable engines, however, have met with proper treatment, and in return have given years of service, costing little or nothing for repairs during a long career. A few of the earliest portable engines, for instance, were so well used that they continued in work for 40 years or more. One of Trevithick's famous engines worked for nearly 70 years.

The portable engine of the present day is a model of good designing and excellent workmanship. A considerable amount of thought has been expended on the several details with the best results, and some engines are not devoid of mechanical refinements.

The men employed to take charge of modern engines are of a higher class, and therefore capable of carefully attending to the refinements. In the manufacture of these engines the latest machine tools and appliances are used. The enormous demand for this useful

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motor during the last 50 years has been remarkable, and thus far there appears to be no signs of any abatement of the orders on hand. One firm alone has made over 33,000 portable engines.

The literature relating to this engine is very meagre and unsatisfactory. In the present paper we propose to chronicle the birth and very early days of the interesting subject, and thus pave the way for future articles of practical importance.

Mr. Smeaton had frequent occasion to employ great numbers of men, and horse-power machinery for pumping. In 1765 he was anxious to use steam power for some of these duties, and a small so-called portable fire engine was designed ; this could be removed from place to place, and readily fixed up, quite independently of any building in which it might be erected, or it could be worked out of doors. A Newcomen condensing engine of peculiar design was shown, fixed to a wood scaffold no less than 40 feet high. Before the engine could be removed it would be necessary to take the frame to pieces, and then be erected again.

This cumbersome machine cannot be termed a portable engine by any stretch of imagination.

The portable engines to be noticed in this paper must follow the recognised lines ; the engine and the boiler will be mounted on a frame, supplied with travelling wheels, so as to be easily removed from place to place by horses, and at once set in position for work. Trevithick's ideas came nearer to these conditions than Smeaton's. It is about one hundred years since Trevithick commenced to build high pressure engines : he adopted the crank ; he used an arrangement for heating the feed-water by means of the exhaust steam, and he dispensed with the condensing apparatus. Trevithick was the "father of the locomotive engine," and it can be shewn that he was the first to use the portable engine for driving a threshing machine. Fig. 1 illustrates his method

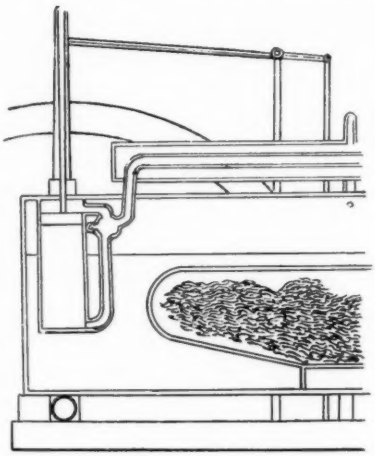

FIG 1.—TREVITHICK'S PORTABLE ENGINE CYLINDER, 1811.

of placing the cylinder inside the steam space of the boiler.

In a letter written to Sir John Sinclair in 1812, Trevithick says : "Respecting the engine for threshing, chaff-cutting, or sawing, I am now making one about two-thirds the size of that made for Sir Charles Hawkins, which will be portable on wheels, and may be removed from place to place as easily

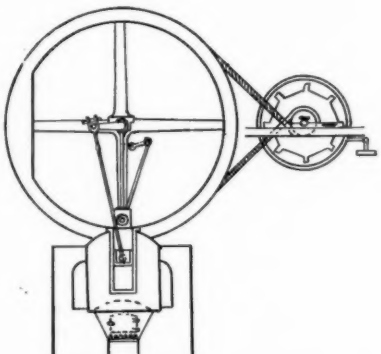

FIG 2.—TREVITHICK'S THRESHING ENGINE, 1812.

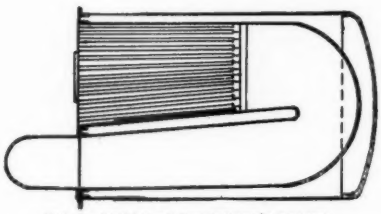

FIG. 3.—BOILER OF TREVITHICK'S ENGINE.

as a one-horse cart." The engine can be fixed in the farmyard, and the machine driven by a belt passing through the barn door, from the fly-wheel to the drum pulley. "The steam can be raised, and the engine moved a distance of two miles, and the threshing-machine at work within an hour. The weight, including engine, carriage, and wheels, will not exceed 15 cwt."

Fig. 2 shews the agricultural threshing-engine supplied to Sir Charles Hawkins, Bart., in 1812. The design evidences simplicity, and consequently moderate price; there was no complication of valve gear, no cylinder cover, parallel motion, guide bars, or air-pump and condenser. Trevithick's portable engines differed from Fig. 2, mainly in the boiler having an inside fire-box, and a flue requiring no brickwork setting. The boiler is shewn by Fig. 3. The next illustration represents one of Trevithick's engines restored by Mr. Webb, of Crewe, to whom we are indebted for the photograph (Fig. 4): the parts of this engine were rescued from a scrap heap and erected by Mr. Webb. It is said that this engine was made by Trevithick's own hands. An engine similar to this was mounted on a species of cart so as to be readily moved from one place to another. Samuel Grove, of Cornwall, makes the following statement: "I saw at the Weath Mine in 1805 a portable high-pressure engine made by Trevithick. It was a 'puffer'; the cylinder was fixed in the boiler. The facility of manufacturing and cheapness of the engines caused them to be much used."

Nathan Gough, of Salford, commenced to make portable and self-moving engines in 1830. The portable engine consisted of a vertical boiler and upright engine, erected on a wooden frame, and mounted upon four travelling wheels. In some cases the engine was made to drive one or more pumps through gearing, the same frame supporting the engine, boiler, and pumps. Fig. 5 shows Gough's portable pumping engine; he made similar engines mounted on wheels for agricultural purposes. A friend of the writer's, living in Manchester, remembers to have seen Gough's engines about the date named; they were similar in appearance to the one illus-

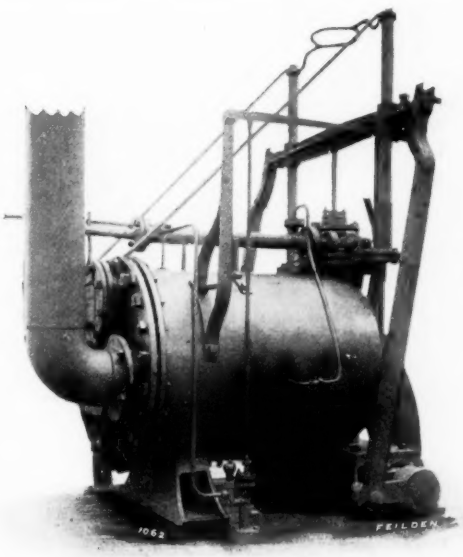

FIG. 4.—TREVITHICK'S HIGH-SPEED ENGINE, 1812. ERECTED FROM PARTS RESCUED FROM A SCRAP HEAP BY MR. F. WEBB.

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trated. In 1839, Howden, of Boston, exhibited at the Wrangle show of the Lincolnshire Agricultural Society a six-horse-power portable engine like Fig. 6. The upright engine is shown at the rear of the return flue boiler. It is related that Howden built twelve engines in all, and then gave up the trade, as he feared that the country would become over-stocked with portable engines. After 60 years' work, during which time portable engines have been built at the rate of about twelve a day, Howden's fears are not realised as yet, the country is far from being over-stocked, the trouble is to send them out quick enough. Recent events have shown how sadly lacking Howden was in faith and enterprise. In 1839 also, Alexander Dean, of Birmingham, made an engine possessing claims to be regarded as portable. One of Dean's later engines is shown by Fig. 7. A larger engine, by the same maker, having two cylinders, is represented by Fig. 8. Dean's portable engines were exhibited at each Royal Show from 1842 to 1847 inclusive.

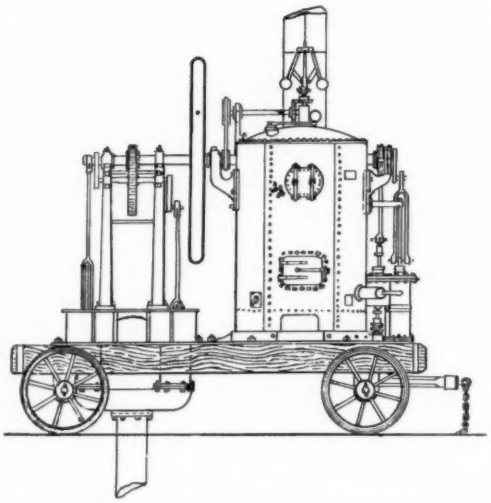


FIG. 5.—GOUGH'S PORTABLE PUMPING ENGINE, 1830.

In 1841 Messrs. Ransomes, of Ipswich, exhibited at the Liverpool Show an engine of the disc pattern, built under the patent of Mr. Davies, of Birmingham. The following year, at the Bristol Show, the same firm showed a modification of the same engine, mounted on four travelling wheels, and having a platform large enough to carry a threshing machine. It could be either drawn by horses, or made self-propelling. This engine received much commendation from the judges of the Royal Agricultural Society. Fig. 9 shows the engine and machine packed up for travelling, and placed in position for work.

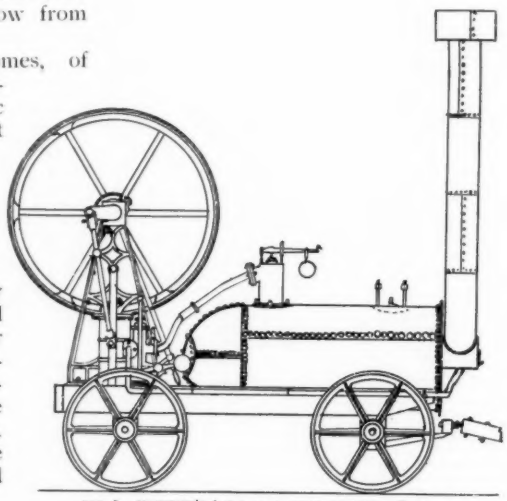


FIG. 6.—HOWDEN'S 6-H.P. PORTABLE ENGINE, 1839.

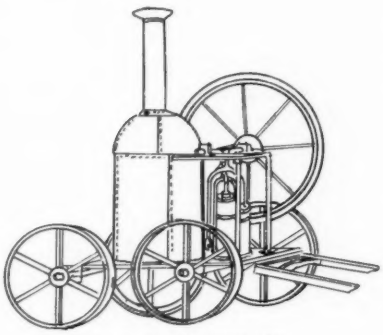


FIG. 7.—DEAN'S ENGINE, 1839.

In 1851 Messrs. Ransomes, of Ipswich, sent a small portable engine to the Great Exhibition; the weight of the engine and the boiler were carried on a channel iron frame, and surmounted on plate springs. The governors were arranged at the smokebox end of the engine, and driven by bent gearing from the crank-shaft. After working for 40 years, the engine was repaired and again sent to work. It is now in full active service and in a good state of preservation, chiefly due to careful handling by the owner (see Fig. 10). In 1855 this firm used outside exhaust pipes, and introduced lock-up safety valves. Stays from the crank-shaft brackets to the cylinder were adopted in 1856.

Biddel and Balk's patent boiler with removable firebox, as Fig. 11, was the product of this establishment in 1858. The inventors were employees of the firm. It is of interest to note that the German portable engine makers are claiming this type of boiler as one of their inventions, but Messrs. Ransomes used the boiler for years before it was made on the continent. From the illustration it will be seen that the firebox and tubes could be withdrawn from the shell, so as to give facility for removing and cleaning out the incrustation and dirt, which is injurious, and cannot be easily removed from boilers of the usual form. In the patent boiler the back tube plate, as well as the front outside plate, were bolted to flanges riveted to the shell. Some years later the well known straw-burning apparatus, as shown by Fig. 12, was the joint invention of the late Mr. John Head, of the firm of Ransomes, Sims and Head,

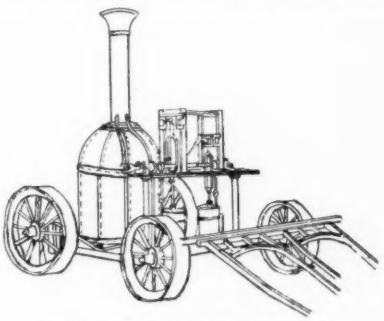


FIG. 8.—DEAN'S TWO-CYLINDER ENGINE, 1844.

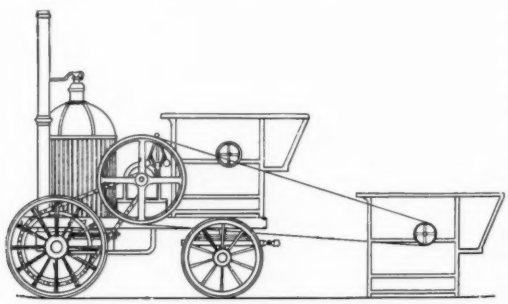


FIG. 9.—MESSRS. RANSOMES' ENGINE AND THRESHING MACHINE, 1841.

and the late Mr. Schemioth, a Russian engineer. Many hundreds of portable engines have been built on this plan by all the leading firms.

Messrs. Tuxford, of Boston, were induced to design a portable engine and threshing machine, both on one frame, as shown by Fig. 13. The first of these was made and supplied in 1842, and worked very efficiently. An

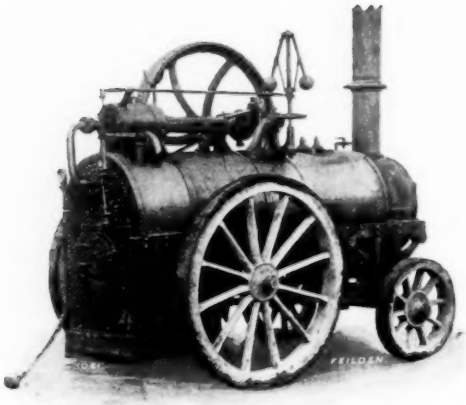


FIG. 10.—THIS ENGINE WAS SHEWN BY MESSRS. RANSOMES AT THE GREAT EXHIBITION, 1851, AND IS STILL AT WORK.

oscillating cylinder was mounted on the boiler as shown. The performance of this combined machine was so satisfactory that six of them were made before the end of 1843. Some years later Messrs. Tuxford introduced an inverted engine, arranged in a sheet-iron box, and placed at the end of the boiler. Fig. 14 shows the boiler of the return tube type; the firebox and the chimney were at one end, and the engine in its box at the opposite end. This peculiar form of engine was first exhibited in 1850, and made for some years afterwards. Some advantages were claimed for this species of engine, but the public evidently preferred the ordinary form of engine fixed horizontally on the boiler, as manufactured by all the leading firms.

Mr. Cambridge, of Market Lavington, made portable engines as early as 1843. It was his practice to place the engine vertically on the top of the boiler, allowing the cylinder to pass into the steam space as shown by Fig. 15. Cambridge built a large number of engines, but he scarcely made two alike.

In 1847 the vertical engines, with the cylinders let into the boilers, gave place to the arrangement shown by Fig. 16. Some of the engines made by Cambridge of this design have

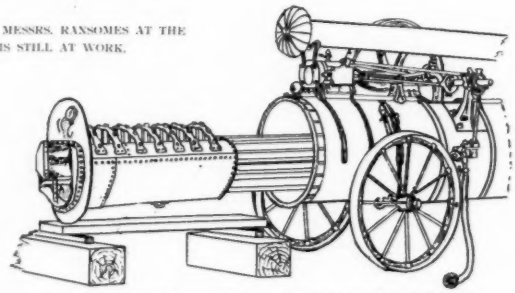


FIG. 11.—A RANSOMES' ENGINE FITTED WITH BIDDEL AND BALK'S PATENT BOILER AND REMOVABLE FIREBOX, 1858.

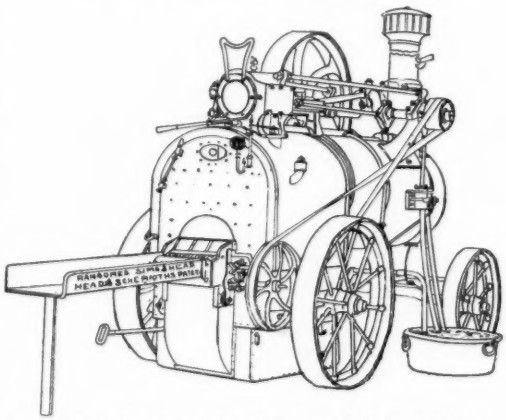


FIG. 12.—A RANSOMES, SIMS AND HEAD ENGINE FITTED WITH STRAW-BURNING APPARATUS.

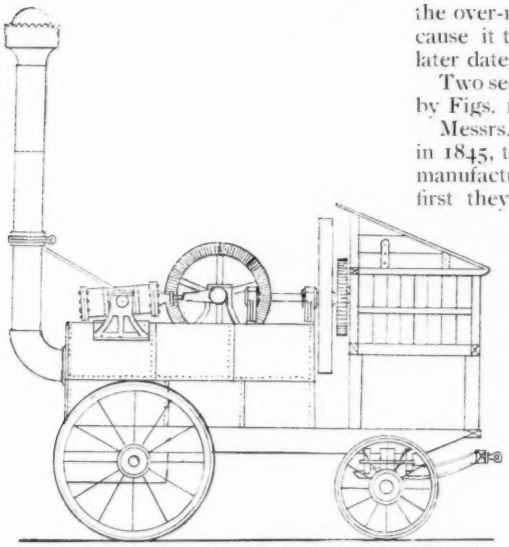


FIG. 13.—MESSRS. TUXFORD'S PORTABLE ENGINE AND THRESHING MACHINE, 1842.

seen fifty years of service, and one or two of them are still at work. The portable engine illustrated was exhibited at Northampton in 1847, when a prize was awarded to Mr. Cambridge. The boiler was closed at each end with a flat plate, the circular flue traversed the whole length of the boiler, and projected beyond the end, the lower part of the chimney was enclosed in an open water tank from which the pump drew its supply. The engine was mounted on four wood wheels, and was a distinct advance on any of the portable engines thus far dealt with; the arrangement of the cylinder, the over-neck crank and other details, cause it to resemble the engines of a later date.

Two sections of the boiler are shown by Figs. 17 and 18.

Messrs. Clayton and Shuttleworth, in 1845, turned their attention to the manufacture of portable engines. The first they made was somewhat crude and cumbersome; it had two cylinders arranged horizontally on a locomotive type of boiler.

On the crank-shaft a spur wheel was keyed, which geared into a pinion on a second shaft; this second shaft carried the flywheel and made three revolutions to one of the crank-shaft. The flywheel shaft was supported by high brackets on a wooden frame, on which the boiler rested also.

In 1846 Messrs. Clayton and Shuttleworth made three portable engines, and eight in the following year. By this time they foresaw that an improved type of portable engine would have a large sale, and the manufacture of engines was destined to become an important industry. They allowed their old business of iron founding to pass into other hands, so that their entire attention could be devoted to agricultural engines and threshing machines. Improvements in the design and arrangement followed each other in rapid succession, thereby placing Messrs. Clayton and Shuttleworth's engines far ahead of any competitors. Fig. 19 shows an engine made in 1849, having the working parts placed on an ordinary multitubular boiler. An over-neck crank, not shewn on the drawing, was used, a long-stroke pump was bolted to the cylinder, the plunger was driven by the cross-head. Both these devices were soon discarded, but there are many engines at work at the present day possessing these old-time characteristics. It will be seen that the barrel

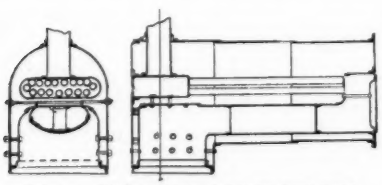


FIG. 14.—MESSRS. TUXFORD'S RETURN-TUBE TYPE BOILER, 1850.

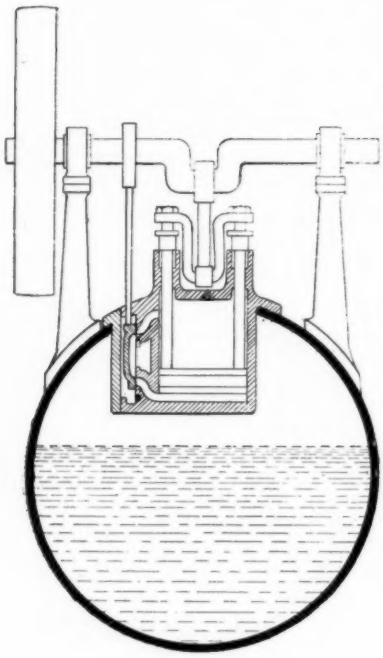
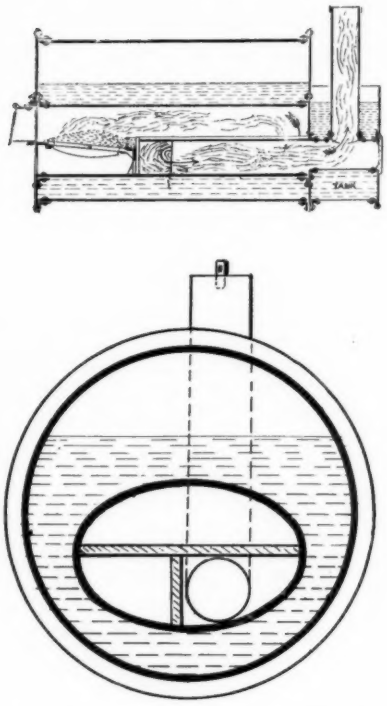


FIG. 15.—CAMBRIDGE'S ENGINE, 1843.



FIGS. 17 AND 18.—BOILER SECTIONS OF CAMBRIDGE'S ENGINE, 1847.

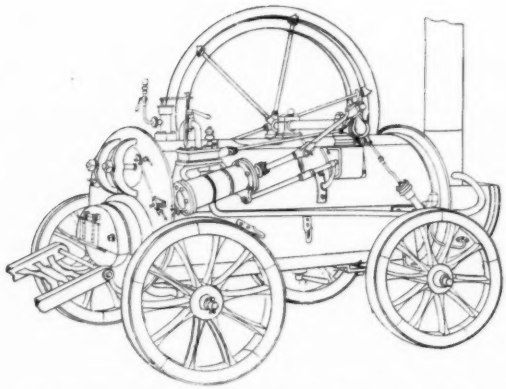


FIG. 16.—CAMBRIDGE'S ENGINE, EXHIBITED AT NORTHAMPTON, 1847.

of the boiler was efficiently lagged and the engine mounted on iron travelling wheels. In 1849 Messrs. Clayton & Shuttleworth entered into competition with other makers at the Royal Show, at Norwich, where they obtained a prize ; they sent no less than three engines of five, seven and nine horse power.

The following table shows the increased efficiency of Messrs. Clayton & Shuttleworth's engines from 1849 to 1853 :

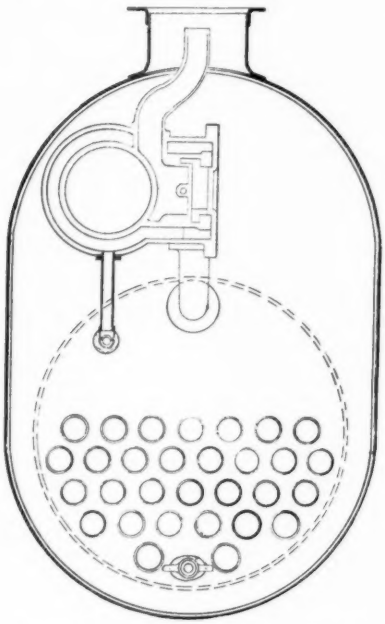


FIG. 20.—MESSRS. CLAYTON AND SHUTTLEWORTH'S INSIDE CYLINDER FOR PORTABLE ENGINE, 1851.

DUTY OF CLAYTON AND SHUTTLEWORTH'S ENGINES AT THE EXPERIMENTS TRIED BEFORE THE JUDGES OF THE ROYAL AGRICULTURAL SOCIETY OF ENGLAND.

Years.	Horses' power.	Time getting up steam to 45 lbs. per inch.	Coal used in getting up steam to 45 lbs. per inch.	Coal burnt per H.P. per hour, while doing the work of one actual horse power.
	H.P. Engine.	Minutes.	lbs.	lbs.
1849	5	44	32·25	11·8
	7	45	37·75	10·78
	9	37	41·25	11·66
1850	7	43	30·5	7·77
1851	6	32	35·4	8·63
1852	6	32½	22·75	6·0
	4	41	29·5	8·40
1853	4	47	17·75	4·32

In 1851, the year of the great Exhibition, Messrs. Clayton & Shuttleworth made no less than 126 engines. The engine presented a comely appearance. In 1853, Messrs. Clayton & Shuttleworth obtained a patent for their portable engines with steam jacketed cylinders placed within the smokebox, a combination which had not been used before. Fig. 20 shows this excellent method of jacketing which greatly increased the economy of their well-known engines. A portable engine fitted with the patent cylinder carried off the first prize at the Royal Show at Gloucester in 1853. Figs. 21 and 22 show portable engine fitted with the patented form of cylinder, and short stroke pumps.

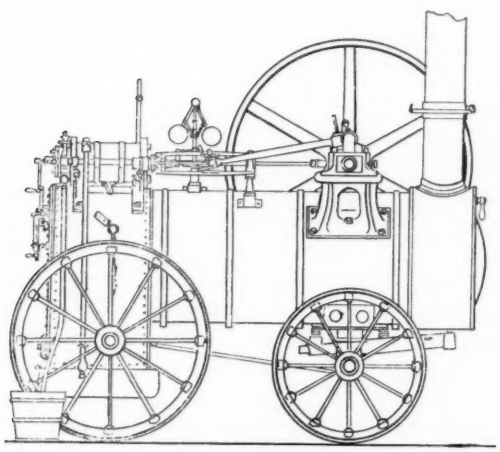


FIG. 19.—MESSRS. CLAYTON AND SHUTTLEWORTH'S ENGINE, 1849.

Messrs. Hornsby and Sons built their first portable engine in 1847, and exhibited it at the Northampton Show. The following year another engine was sent to the Royal Show at York; the engine was tested under the brake and a prize of £50 awarded to the makers. Fig. 23 shows

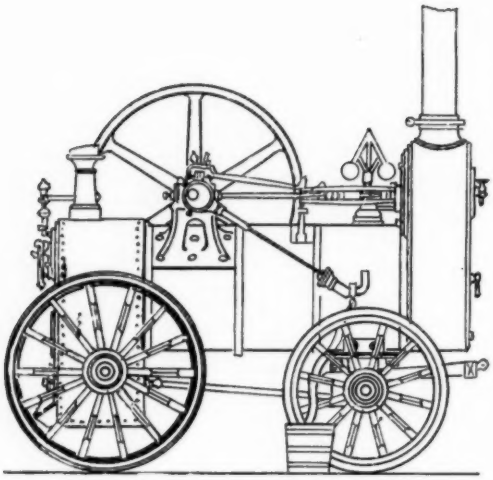


FIG. 21.—MESSRS. CLAYTON AND SHUTTLEWORTH'S ENGINE WITH STEAM JACKETED CYLINDERS, 1853.

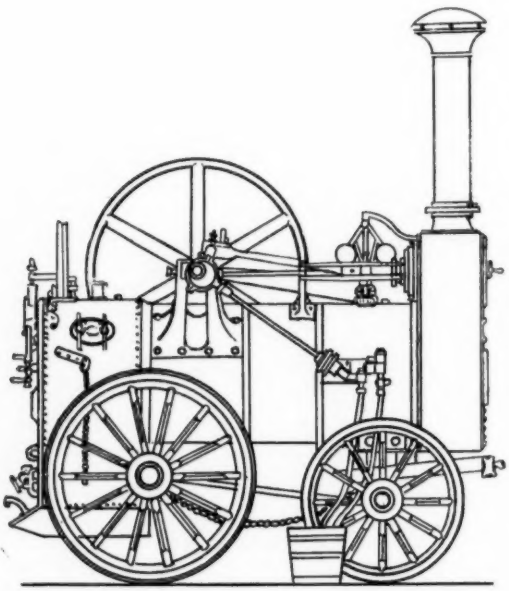


FIG. 22.—MESSRS. CLAYTON AND SHUTTLEWORTH'S PATENT CYLINDER ENGINE, EXHIBITED AT GLOUCESTER, 1853.

the type of engine built by Messrs. Hornsby at that period. This pattern was superseded in 1851, when the patent engine (having the cylinder placed horizontally in the upper portion of the firebox shell) was introduced, as shown by Fig. 24. This type of engine carried off the first prize at the Great Exhibition. At the Lewes Show in 1852 Messrs. Hornsby were equally successful, where seventeen other engines were tried. The system of jacketing by placing the cylinder inside the steam space of the boiler, introduced by Trevithick, followed by Cambridge, and then by Hornsby, conduced to economy. A later and neater form of engine is shown by Fig. 25. The cylinder and the valve chest are buried in the highest projection of the firebox shell, and immersed in steam of the full boiler pressure. Cast-iron crank-shaft brackets of peculiar design are shown, and from them to the steam case extend two stays which brace the brackets and the case together; the stays pass through the case and act as additional supports, having lock nuts inside and outside the steam case at each end, as shown by the sketch, Fig. 26. "A point of old practice about this engine is that the exhaust pipe passes inside the boiler. This was the invariable mode of construction for years.

"At last it was suggested that the internal exhaust pipe did harm, carrying off to waste a great deal of heat from the steam in the boiler. To settle the point Mr. Bonnal, the foreman, ran an engine fitted with two exhaust pipes, one within and the other without the boiler, either of which could be used at pleasure on the brake for at least double the time required to make runs in a show-yard. Some runs were made with the outside

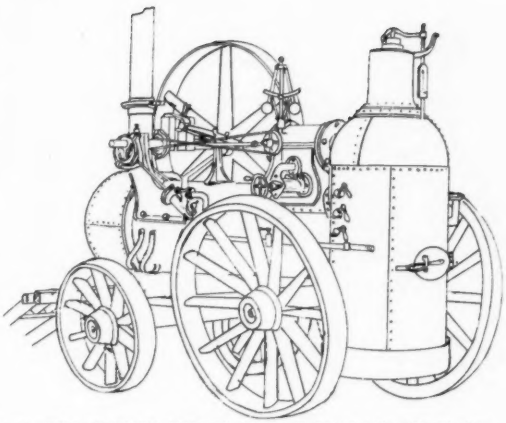


FIG. 23.—TYPE OF ENGINE BUILT BY MESSRS. HORNSBY AND SONS IN 1849.

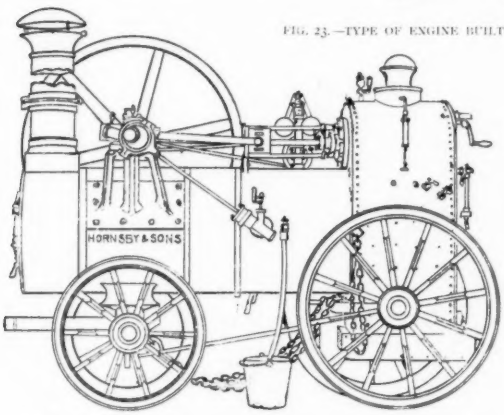


FIG. 24.—MESSRS. HORNSBY AND SONS' ENGINE THAT CARRIED OFF THE FIRST PRIZE AT THE GREAT EXHIBITION, 1851.

and some with the inside pipe; the result was, curiously enough, if anything, in favour of the internal pipe. The exhaust steam being kept dry, the back pressure appeared to be slightly reduced in a way which has been well explained by Mr. D. K. Clark, when writing about outside cylinder locomotives. We have here an example of a special mode of construction which was found by experience to answer well in practice, although opposed to certain theoretical considerations which seem to be rather too fine spun." *

Messrs. Garrett and Sons first entered into competition with other makers of

* "The Engineer," July 4th, 1874.

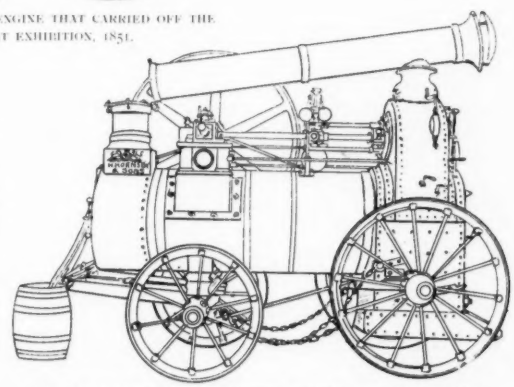


FIG. 25.—A LATER TYPE OF MESSRS. HORNSBY AND SONS' ENGINE.

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portable engines at the Norwich Show of 1849, where they obtained the first prize. The cylinder of the prize engine was mounted on a tubular boiler, with a cylindrical firebox within a cylindrical casing, while the crank-shaft carriage was arranged so that the four bearings of the crank could be bored out at once. At the same Show the Leiston firm exhibited a second engine ; the boiler in this instance had two direct side flues and a single return flue ; the performance of this boiler was well spoken of by the judges of the Royal Agricultural Society. The feed-pump of this engine was of the continuous acting type, so arranged that the amount of feed-water entering the boiler could be regulated by a cock, the water not required being returned to the tank. Messrs. Garrett were the earliest makers to employ wrought iron in preference to cast iron for the details of their engines : they had wrought iron brackets for the crank-shafts of some of their portable engines as early as 1852.

The next two interesting illustrations, Figs. 27 and 28, show end views of a portable engine made by Messrs. Garrett & Sons, and exhibited at the Great Exhibition of 1851. It will be seen that the cylinder was placed on a multitubular boiler. The crank-shaft was supported in combined bearings fixed to the smokebox. A tank was provided beneath the smokebox, from

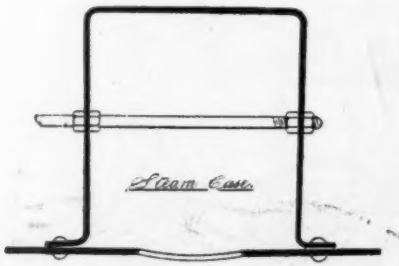
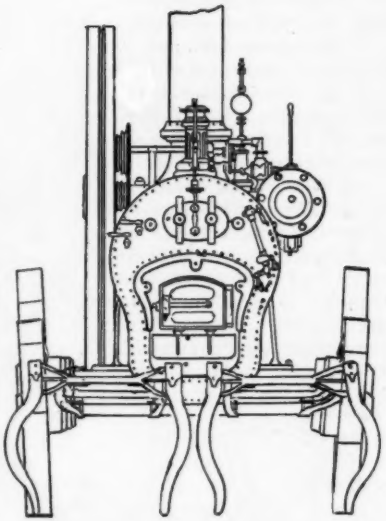
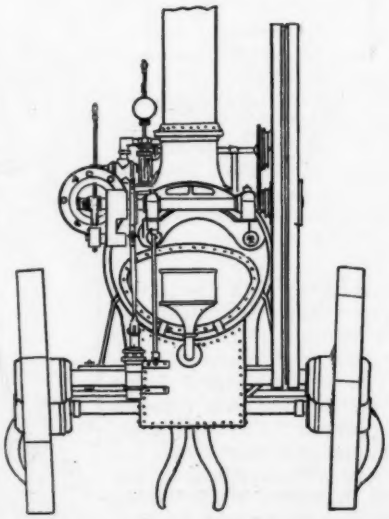


FIG. 26.—STEAM CASE OF MESSRS. HORNSBY AND SONS' ENGINE.





FIGS. 27 AND 28.—END VIEWS OF A PORTABLE ENGINE MADE BY MESSRS. GARRETT AND SONS FOR THE GREAT EXHIBITION, 1851.

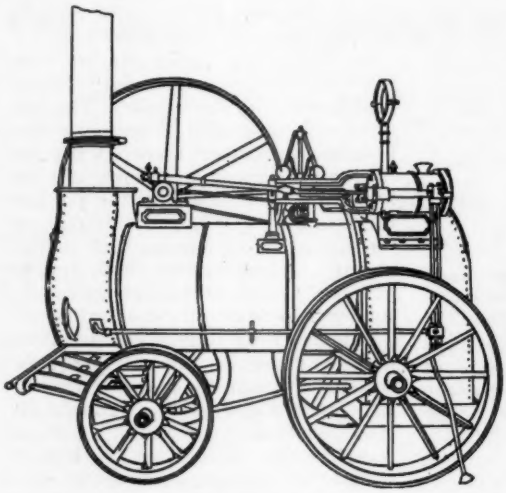


FIG. 29.—MESSRS. BURRELL AND SONS' ENGINE, ENTERED FOR TRIAL AT THE GREAT EXHIBITION, 1851.

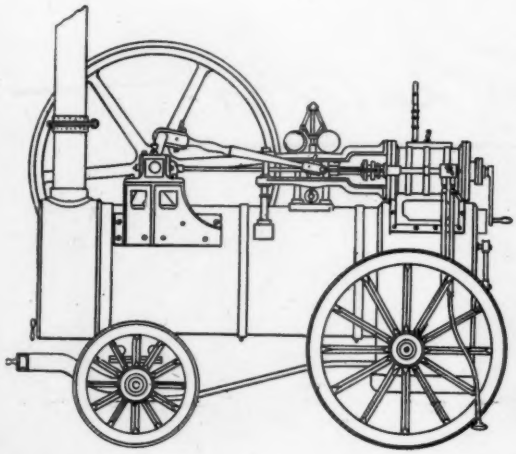


FIG. 30.—ENGINE AS MADE BY MESSRS. BURRELL AND SONS, 1853.

which the vertical feed-pump drew its supply of water.

Messrs. Burrell and Sons commenced to make portable engines in 1850. Among the engines on view, and entered for trial at the London Exhibition in 1851, this firm's production found a place. Fig. 29 shows the engine; it had an over-neck crank, a fork end connecting-rod, and a long stroke pump actuated from the cross-head gudgeon. The governors were arranged so that the engine could be run at three different speeds, a plan which the firm retained for many years. It will be noticed that the boiler was neatly lagged with wood, and the engine mounted on wood travelling wheels. From the judges' report of the Exhibition we extract the following: "The arrangement of the working parts of this engine is simple and good."

Fig. 30 shows one of Messrs. Burrell's later portable engines. It had an inside crank; substantial crank-shaft brackets are shown, and a hot water cistern with an apparatus was applied for pumping hot and cold water, by means of which a saving of fuel was effected. An engine of this type was exhibited at the Gloucester Royal Show in 1853; the judges said: "The above engine was found to be both simple and well-proportioned in its construction, and a useful farmer's engine."

The following is a list of the makers of portable engines who competed at

the trials of the Great Exhibition of 1851, and the results of the trials :—

PRACTICAL RESULTS OF THE TRIALS.

Maker.	Horse power	Time of getting up steam.	Coal used ingetting upsteam.	Coal used per H.P. perhour.
	No.	Min.	lbs.	lbs.
Hornsby and Son..	6	49	35·23	6·73
Tuxford and Son...	6	53	56·68	7·46
Clayton and Shuttle-worth	6	32	35·40	8·63
Garrett and Sons...	5	42	26·50	8·65
Barrett and Co. ...	4·5	26	25·56	9·20
Tuxford and Son...	4	41·5	35·60	10·85
Cabron	9	44	52·00	12·48
Burrell and Son ...	6	28	35·00	13·10
Butlin	4·5	50	42·00	14·71
Hensman and Son	4	33	29·00	18·75
Roe and Co. ...	4	83	75·20	25·8

The horse-power was measured by means of a Proney's brake, on the plan adopted by the Royal Agricultural Society.

It will be seen that Messrs. Tuxford & Son entered two engines of different sizes ; the results are shown.

Of the ten makers who sent engines for competition in the trials of the 1851 Exhibition only four remain ; they are Messrs. Burrell, Clayton and Shuttleworth, Garrett and Hornsby.

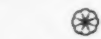
In the present paper the first forty years of the portable engine's history has been briefly dealt with. The progress was slow after Trevithick's day, because the makers favoured the vertical form of engine, which did not lend itself very readily to the portable requirements. When Cambridge entered the list of makers with a horizontal engine success was quickly achieved. The horizontal engine and multitubular boiler have stood the test of time. Other forms have been tried and discarded ; the present type introduced by Cambridge and improved by later manufacturers is, undoubtedly, "the survival of the fittest."

In another article we purpose to notice the portable engines of more modern times : this will include the productions of firms of wide reputation, such as Messrs. Marshall, Sons & Co., of Gainsborough ; Messrs. Robey & Co., of Lincoln ; Messrs. Ruston, Procter & Co., of Lincoln ; Messrs. Brown & May, of Devizes ; Messrs. E. R. and F. Turner, of Ipswich, and others.

W. Fletcher.

The Leen Valley Branch of the Great Northern Railway Co.

(By Our Special Commissioner.)

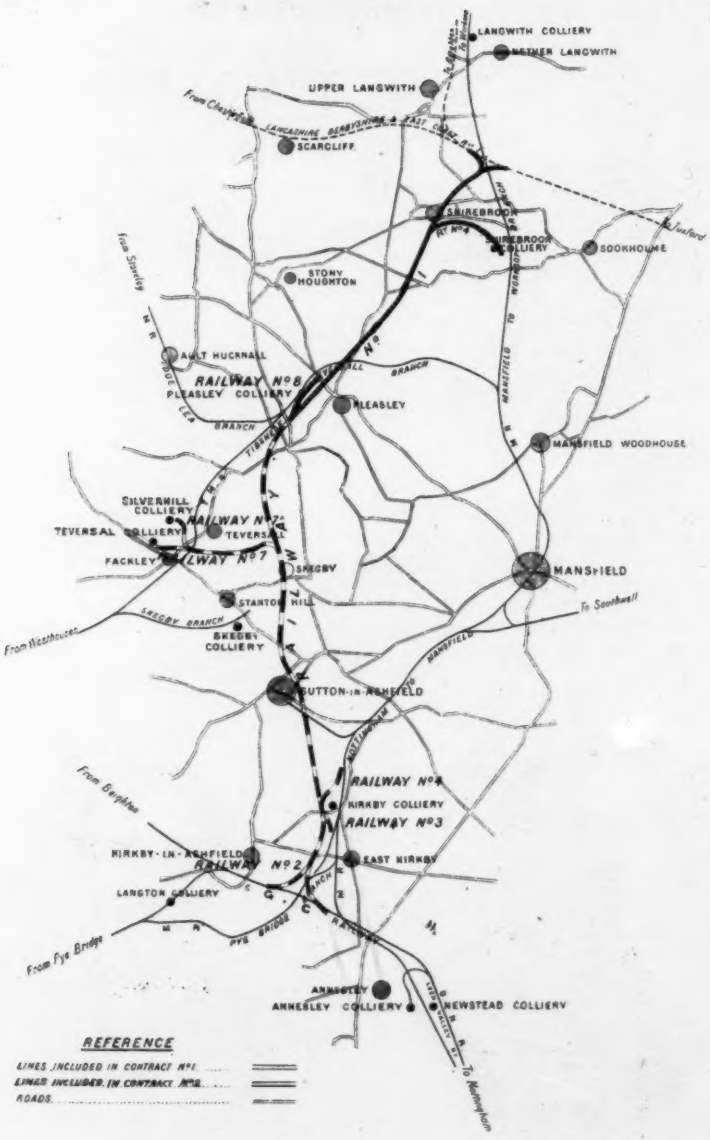


The opening of the Great Central Railway Company's new branch line to London commences a new phase in the history of the Great Northern Company. In meeting the competition which will inevitably follow the opening of so great an undertaking, the Directors of the Great Northern Railway Company have constructed in Manchester a large goods depôt adjacent to the Central Station, the property of the Cheshire Lines Committee, in whose undertakings they are already interested to the extent of £4,000,000, a new line in Nottingham joining their existing line to the Central Station, which is a joint property belonging to the Great Northern and Great Central Companies, and have, during the past five years, had under construction in Nottinghamshire and Derbyshire a line some 14¼ miles in length, tapping some of the most important collieries in those counties. It is this portion of the enterprise we now are particularly dealing with. The whole of the coal traffic carried from these districts will be brought into the marshalling yard at Colwick, five miles east of Nottingham, and there sorted, prior to being sent south. From a very modest beginning the Colwick yard has become one of the most extensive in the kingdom, comprising as it does not less than 32 miles of sidings.

The work now about to be described is an extension of the Leen Valley Railway, which was opened for traffic

MR. ALEXANDER ROSS,
Chief Engineer, Great Northern Railway.

MR. H. W. SADLER,
Chief Assistant Engineer, Great Northern Railway.



MAP SHEWING THE ROUTE OF THE LEEN VALLEY BRANCH G.N.R.

MR. W. H. HUTCHINSON.
The Contractor for the New Branch.

in 1882. The new line has been made in two sections, the first commencing by a junction with the existing railway at Annesley, but to avoid the great expense of driving a tunnel through the Robin Hood Hills, an agreement was come to with the Great Central Railway Company for running powers through their Annesley tunnel. Branching off some 450 yards north of this, the actual construction of the new railway commences by a deep rock cutting; out of which 88,364 cubic yards have been excavated. Emerging from this cutting, it crosses the Pye Bridge Branch of the Midland Railway by a bridge of two spans, one of which is not used, but is built to provide for future developments of the Midland Company. Continuing northwards it passes through the village of Kirkby, and then comes the first of the big collieries this line is provided for—that of the Butterley Company's Kirkby pit, which is reached by two branch lines, each 58 chains long, one leading to the empty sidings, the other to the fulls. One hundred and nineteen chains of sidings have been laid in, so that the accommodation is in no way neglected. At present only the "top-hard" coal seam (known in South Yorkshire as the Barnsley bed) is worked at this pit. There are two shafts, each 15 ft. diameter and 365 yds. deep, sunk through water-bearing strata in the magnesian limestone, and lined for 110 yds. with cast-iron tubbing plates. Both shafts are arranged for drawing coal, but at present only the south or downcast shaft is used for that purpose. The present output of coal is about 1,200 tons per day. When further developed, about 4,000 tons per day could be obtained from these two shafts. The cages have two decks, each carrying two tubs of coal of 15 cwt. nominal capacity, and unloaded simultaneously on two landings, one 7 ft. 4 in. above the other. On the pit-bank, at each landing, there is an Everett patent tippler, designed to empty four tubs per minute into the main screen, whence the coal goes on to a travelling cleaning band 280 ft. long, on which the coal is cleaned and sorted and hand picked into best hard locomotive coal, steam hard, soft cobbles, and mixed cobbles, and placed into trucks; the remainder is elevated and further cleaned and mechanically sized into screened cobbles, nuts, and smitham. The colliery is lighted throughout by electricity, and includes the usual shops and appliances, and is well equipped and situated for sending excellent clean coal into the midland and south country markets.

After leaving this colliery, the Sutton cutting is entered, containing 213,000 cubic yards of excavation. A feature of interest in this cutting, is the bridge under the Midland Railway Company's Sutton-in-Ashfield branch. So as not to interfere with the Midland Company's traffic at this point, a dumpling was left in the cutting until the brickwork of the abutments had been built in trench, and the new steel girders and flooring rivetted up on timber staging alongside. The bridge was then asphalted and ballasted and the perman-

ent way laid ready upon it. After the last Midland train had passed up the branch at 12 o'clock midnight on a Saturday, the permanent way was torn out, and the new bridge drawn into position by means of wire ropes and crab winches, the whole lowered into position and fixed in time to allow the first train to pass over at 8 o'clock on the following morning.

Situated in this cutting, at four miles from the commencement of the line, forms on either side being reached by a flight of stone steps. On both sides are gentlemen's and ladies' waiting rooms. Leaving the station yard, the line enters the Skegby cutting, containing 105,000 cubic yards. It is 34 chains in length and of an average depth of 30 feet. The nature of the excavation was chiefly magnesian limestone, covering a big surface, but of very little vertical thickness. The stone is used in the district for road-mending

BRIDGE OVER THE PYE BRIDGE BRANCH OF THE MIDLAND RAILWAY.

Sutton-in-Ashfield is reached, at which town a passenger station and goods depôt have been built. It appears as though this were amply justified, in that the population of this town has increased from 7,574 in 1881 to 10,560 in 1891. The inhabitants are chiefly employed in the collieries and in the manufacture of hosiery. The booking-hall, like the rest of the station buildings, is a substantially built stone erection, spanning the line, the platand burning for lime. At the north end of the cutting is the village of Skegby, where a passenger station and goods yard have been built. The booking-hall, offices, etc., are, like Sutton, built in stone, but instead of being over the line are situate on the road, and the platform is reached by means of a glazed brick sub-way and steps. On both the up and down platforms, ladies' and gentlemen's waiting rooms are provided and built of wood.

BRIDGE IN POSITION, CARRYING MIDLAND RAILWAY, SUTTON-IN-ASHFIELD BRANCH, OVER CUTTING.

Skegby is only a small place of about 3,300 inhabitants, but is the centre of a big agricultural district, and near to this village is situate Hardwick Hall, one of the seats of the Duke of Devonshire.

About a quarter of a mile to the north of this village a branch line, 2 miles 19 chains in length, extends to the Silverhill and Teversal Collieries, the properties of the Stanton Coal and Ironworks Co., Ltd. The works on this length were not heavy, the excavation amounting but to 60,400 cubic yards. There were 10 bridges, chiefly built in stone with steel tops, the one under the Midland Railway Teversal Branch being rolled in in a similar manner to that already described at Sutton-in-Ashfield.

At Teversal Colliery there are two shafts, the downcast being 14 ft. in diameter, and the upcast 11 ft. in diameter. Each are 217 yards deep to the "top-hard" coal. Only the downcast is used for drawing coal. The cleaning and sorting arrangement is an exact duplicate of that in use at Pleasley.

At Silverhill Colliery there are two shafts, each 15 ft. in diameter and 418 yards deep to the black shale. Winding engines are fixed to both pits, the one drawing the whole of the black shale and part of the low main coal, and the other low main coal only. The underground haulage is done by an engine with one cylinder, 22 in. and 48 in. stroke, which is supplied with steam from a water-tube boiler of 95 h.p.

Leaving Skegby Junction, the main line follows the valley of the River Meden, and is carried on a long bank 52 chains in length, at the end of which the Pleasley Colliery, belonging to the Stanton Company, is reached. It is to this point that Section No. 1 of these extensions was opened in the spring of last year.

There are 42 bridges, mostly built with masonry abutments and ordinary steel-plate girders with trough flooring,

and 867,487 cubic yards of excavation were carried from the cuttings to embankments. The work took four years to complete.

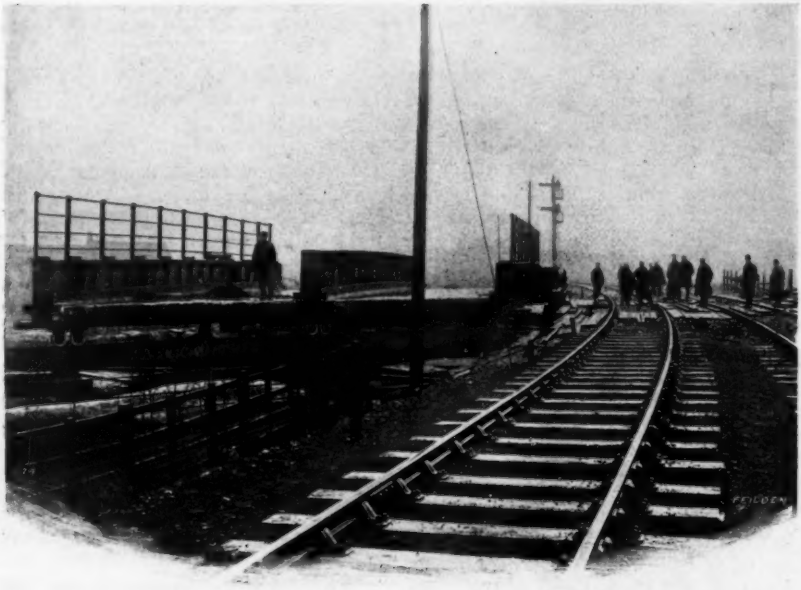
At Pleasley Colliery, belonging to the Stanton Coal and Iron Co., there are two shafts, each 14 ft. 6 in. diameter, and 514 yards deep, sunk to the "Barnsley" or "top-hard" coal of Derbyshire. The cleaning and sorting of the coal into the various qualities is done by means of endless belts and jigging screens. There is an electric plant at this pit, conveying current to five motors underground, and 138 16-candle-power incandescent lamps.

The output of coal from the three collieries belonging to the Stanton Company is about 1,000,000 tons per year ; 615 workmen's cottages are provided, and there are schools and institutes at Stanton Hill and Pleasley.

Contract No. 2 extends from Pleasley to Langwith, and the works are exceedingly heavy, and although only half the length of No. 1 the cost of construction exceeds it.

The bulk of the work lies in *one big cutting*, containing 632,160 cubic yards of rock excavation. It is 1 mile 18 chains in length, and of an average depth of 42 ft., the deepest point being at Shirebrook, where it is 58 ft. deep.

There are many striking features in the geological strata of this cutting. At the south end, for a distance of 44 chains, the stone is of a red tint, probably a white freestone coloured with an infiltration of iron. It makes a magnificent building stone, and is being used in the construction of all the bridges, dressing up into very fine facework and ashlar. It is a stone similar to that found in quarries to the east of



THE BRIDGE UNDER THE MIDLAND RAILWAY, SUTTON-IN-ASHFIELD, READY TO BE DRAWN INTO POSITION.

the railway at Mansfield, and was used in the terrace of Trafalgar Square, and spoken of by Sir Gilbert Scott as "one of the best building stones in the kingdom." This stone loses itself 44 chains north in the cutting, turning into loose boulders mixed with clay. This, however, lasts for no great distance, but transforms into magnesian limestone, a massive irregular-bedded crystalline

"lifts," the top being excavated by Ruston & Proctor's steam navvies to the full top width, and a depth of about 14ft., the excavation having to be blasted by gelegnite or other high explosives before being filled. Rock-drills driven by compressed air are used for the purpose of putting down the holes to receive the explosives. The second "lift" is proceeded with when the

SUTTON-IN-ASHFIELD STATION AND YARD.

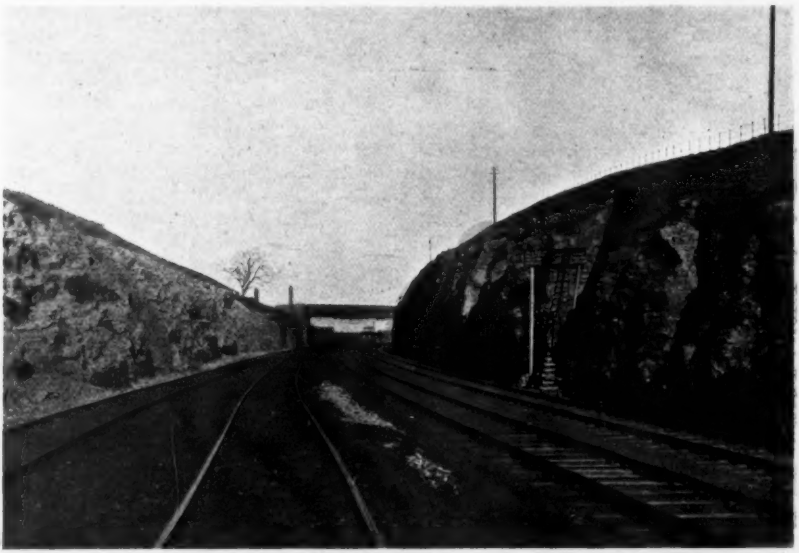
yellow, speckled with black. Southwell Cathedral was built from this bed, and the foundation and lower part of the Houses of Parliament. Reaching to 71 chains we come across 10 chains of sand and loam, emerging into a perfectly white freestone of a very hard nature. Unfortunately, all these beds of stone are very local, and, as stated, at a comparatively short distance they alter completely in character.

The cutting is being worked in three

steam navvies have got sufficiently far ahead to give room for driving a "gullet" about 14 ft. wide. The rock is filled into skips by hand, which are then hauled out of the "gullets" by means of steam cranes, and loaded into wagons standing on a separate road. When this stage is sufficiently advanced, wagons are placed on the wings and filled by hand, as many as 20 wagons being worked in a set, the whole process being repeated on the bot-

tom lift. The cutting is worked both at the north end and the south in a similar manner ; two Ruston & Proctor's navvies and eight steam cranes were used in addition to the hand gangs excavating the wings. The cutting was worked in ten different places at the same time, and necessitated the employment of eight locomotives to carry the excavation to the banks. It can readily be imagined from the employment of so much power in one cutting, and the manner it is laid out, that great progress has been made, it being quite anticipated that it will be completed by the first of June of this year. A start having been made on the 12th Jan., 1898, this vast amount of rock will have taken less than two-and-a-half years to excavate and tip into embankments.

The boring in the "gullets" and in front of the steam navvies was done by machine drills, two makes being used, that by "Schram" being driven solely by compressed air, and the "Ingersoll-Sergeant" by steam and compressed air. As many as eighteen drills were being worked at the same time. A special feature of the "Schram" type of machine is that they work on the compound principle, *i.e.*, the charge of compressed air which has been used to make the forward stroke, instead of being exhausted, is again utilised to make the backward stroke, with the result that there is only *one* exhaust for each double stroke instead of *two* as in rock drills of ordinary construction. The effect of this is that considerable economy in the consumption of compressed air is effected, which means a corresponding saving in fuel, a less water supply (for boilers), &c., which it will be readily understood is a matter of considerable importance on a contract of this description. The compressed air was supplied from one of



END OF SECTION NO. 1, SHEWING CHIMNEYS OF PLEASLEY COLLIERY IN DISTANCE.

QUARRYING THE RED STONE OUT OF THE CUTTING FOR BRIDGE BUILDING.

AT WORK ON THE WINGS; BOTTOM LIFT SHEWING CRANES AT WORK IN THE GULLET IN THE DISTANCE.

Schram's direct acting tandem air compressors driven by a loco-type boiler. The cylinders of this compressor are water jacketed to counteract the heat which naturally arises through the air being compressed in the cylinder. The air is passed through pipes to a general receiver, and from thence along the top of the cutting through wrought iron pipes with T pieces at regular intervals, to which branch pipes are attached from time to time as the work proceeds, and connected to the drills by means of a flexible rubber hose.

DRIVING THE GULLET BOTTOM LIFT, NORTH END OF SHIREBROOK CUTTING.

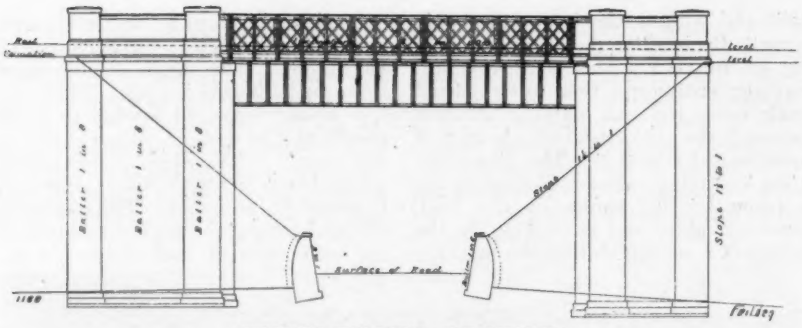
Many special features are also embraced in the Ingersoll-Sergeant 3¼ in. diameter cylinder drill. The mounting for this drill is a simple tripod, with a universal joint arrangement. It has telescopic legs, with pointers and set-screws, so that it can be fixed at any level to suit the uneven surfaces which are generally met with on the slopes of railway cuttings. The jaw and saddle at apex of tripod embraces the conical spigot attached to the cradle of drill, and is capable of being adjusted to any varying position from horizontal to perpendicular. This percussive rock-drill combines an independent valve, operated through an auxiliary valve which, in turn, is actuated by shoulders upon the piston. This arrangement opens or closes the steam or air passages, releasing the pressure at each end of the main valve alternately. There are only two quick-moving parts —the valve and the piston—and one obvious advantage of this reduced number of working parts is that it is all the less liable to get out of order. A variable stroke can be obtained at

will, and without cushioning the blow, simply by feeding the machine close up to the rock. This is a great advantage, enabling a hole to be started with ease, and can only be attained properly by the machine having a positive valve motion. The time occupied in drilling varies considerably according to the nature of the rock operated upon, and in working on the wings of a cutting, shifting the machine from one point to another occupies considerable time, especially when a crane is out of reach. A depth of 12 ft. in an hour, including changing bits, pumping out hole, etc., has often been accomplished.

At the end of the big cutting is the site of the Shirebrook station yard, and the junction of the branch line, ¾ mile long, to the Shirebrook Colliery, a new undertaking, the pit not having long been opened. At this point there are two shafts, each 19 ft. diameter, sunk to the Barnsley bed or top hard coal of Derbyshire. The depth of this seam from the surface is 544 yds. The plant is of modern type, the workshops being the largest and most commodious in the county. The output is now about 400,000 tons per year, but is expected to reach 750,000 tons. The quality of the coal compares very favourably with the same class of coal worked at the neighbouring collieries. There is a large model village in connection with the colliery, consisting of about 400 well-built and prettily situated houses.

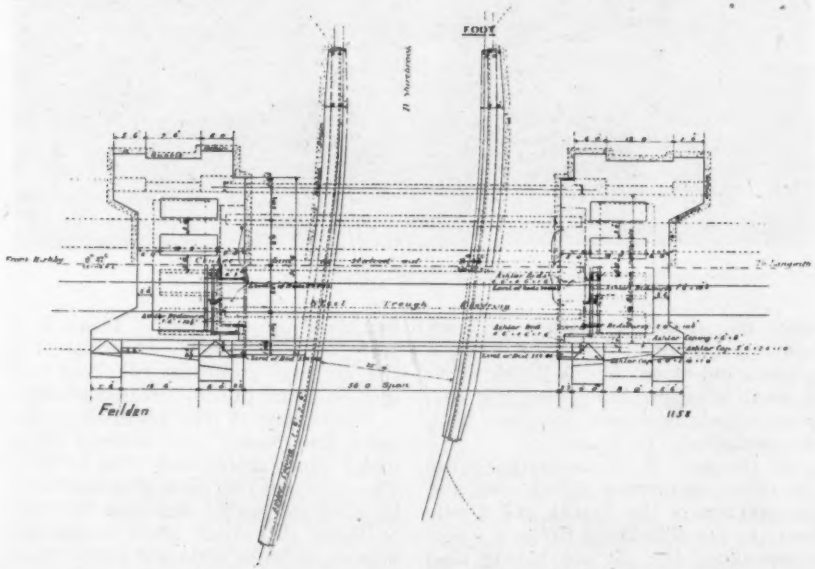
SHIREBROOK ROAD BRIDGE.

Proceeding 1½ mile northwards, the main line passes over a deep bank, under which there are five big bridges. The accompanying photograph of Shirebrook Road bridge illustrates the type of them all, which when completed look exceedingly solid and well. They are mostly of steel, with masonry

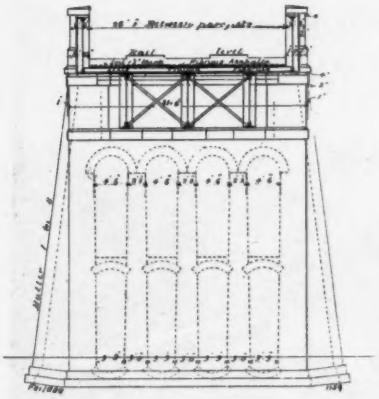


SHIREBROOK ROAD BRIDGE. EAST ELEVATION.

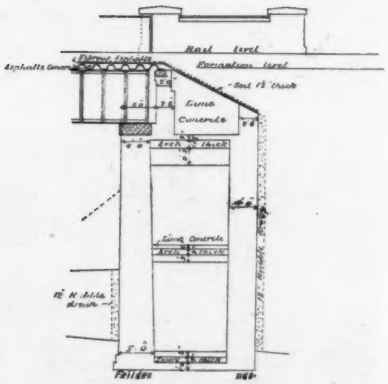
abutments and wings; the engineer preferring in all cases not to adopt arches, owing to the numerous colliery workings underneath. The masonry is faced throughout with the red stone quarried from the cutting, the tooled ashlar in the pilaster caps, coping and girder beds being of Derbyshire grit stone. The largest bridges are four under-bridges across public roads, in the big Shirebrook Embankment, between 8 miles 48 chains and 9 miles 3 chains, and the Wood Lane over-bridge at 7 miles 52 chains. The bridge over Shirebrook road may be taken as typical of the former class. It is 56 ft. in clear span and 37 ft. high from road to rail level. The abutments are pocketed, and the weight on the concrete foundation is about 3½ tons to the square foot,



SHIREBROOK ROAD BRIDGE. HALF PLAN OF SUPERSTRUCTURE AND HALF PLAN ABOVE FOOTINGS.



ELEVATION OF NORTH ABUTMENT.

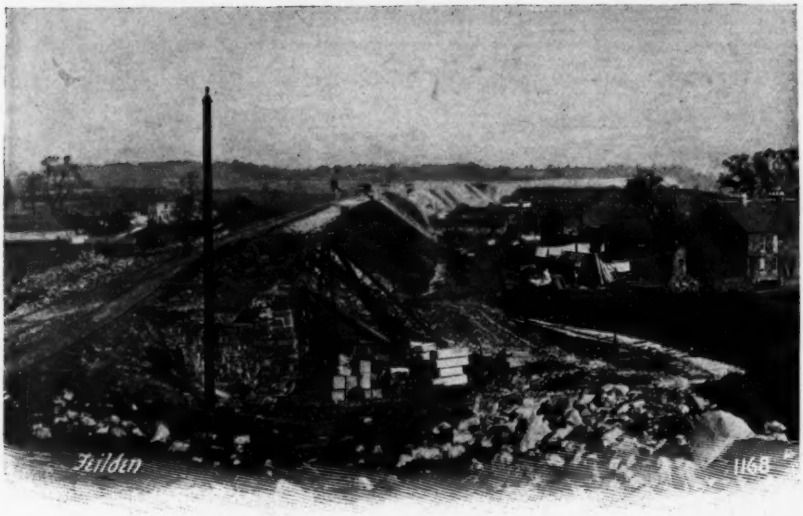


LONGITUDINAL SECTION OF NORTH ABUTMENT.

SHIREBROOK ROAD BRIDGE.

including rolling load. There are no wing walls, as the abutments are of the type known as "block" abutments, and the toe of the embankment is kept from coming into the roadway by retaining walls 6 ft. high, built parallel to, and 15½ ft. from the face of the abutments, thus giving a clear roadway width of 25 ft. The main girders, three in number, are of the ordinary plate type, and are so spaced as to be equally loaded. They are 63 ft. 6 in. long, 7 ft. deep, and 1 ft. 8 in. wide, placed 8 ft. centres, and braced together with a cross bracing of 6 in. × 3 in. × ½ in. T irons. They are decked over with steel trough flooring, filled with asphalte concrete, the ends of which rest on the bottom flange of the parapet girders, which are of the lattice type and 7 ft. 3 in. deep. There is a clear width of 26 ft. 1 in. between parapets. The section of the outside main girders at the centre consists of web ⅜ in. thick, and two ½ in. plates in both top and bottom flanges connected with web by 4 in. × 4 in. × ⅝ in. angle irons; the flanges of the central main girder are $\frac{1}{16}$ in. thicker than those of the outside girders, but in all other respects the dimensions are identical. The Wood Lane Bridge, which has the longest span of any on the line, carries a public road over the railway at 7 miles 52 chains. The skew span of this bridge is 81 ft. 4 in., and the two main girders are 93 ft. 6 in. in length, 8 ft. 6 in. deep, and placed 19 ft. centres. Cross girders are 26 ft. 2 in. in length, 2 ft. deep, placed 10 ft. centres, and rest on the top of the main girders, and these are again decked over with trough flooring filled with asphalte concrete. The flanges of the main girders, which are 2 ft. wide, are made up of two ½-in. and two $\frac{7}{16}$ in. plates at the centre, the web plate being $\frac{7}{16}$ in. thick. The parapets consist of light lattice girders, 6 ft. high above the level of the road, and the total depth of steelwork from the top of the parapet to the bottom of the main girders is 19 ft.

There is a small cutting from 9 miles 10 chains to 9 miles 39 chains, after which the line connects with the Lancashire, Derbyshire and East Coast Railway at the Langwith Junction station, thus gaining access on the west to Chesterfield, on the north to Sheffield, and on the east to the "Dukeries." There are in all 20 bridges on this Contract No. 2, containing some 14,000 cubic yards of



GENERAL VIEW OF THE BIG BANK AT SHIREBROOK.

masonry and 869 tons of steelwork. In addition to the extensive coal traffic certain to be obtained, a large excursion traffic is anticipated to the "Dukeries," including Welbeck, the seat of the Duke of Portland; Clumber, the seat of the Duke of Newcastle; Thoresby, the seat of Earl Manvers; Rufford Abbey, the seat of Lord Saville; and Hardwick Hall, one of the seats of the Duke of Devonshire. At Chesterfield are situated the works of Messrs. C. Markham & Co., where it may not be generally known the Schram air compressors and rock drills are made, and a visit to these works is well worth anyone's time, for there may be seen all the very latest electrical appliances, and one of the finest tool shops in the country.

The work in connection with this extension was commenced under Mr. Richard Johnson, M.I.C.E., the late chief engineer to the Great Northern Railway Co.; but since his retirement by Mr. Alexander Ross, M.I.C.E., who succeeded him. Acting under Mr. Ross are Mr. H. W. Sadler, M.I.C.E., chief assistant, and Mr. J. Lee, Assoc. M.I.C.E., resident engineer. Mr. W. H. Hutchinson, Assoc. M.I.C.E.. of Mansfield is the contractor of contract No. 2. The Horsely Co., Tipton, supplied the steelwork for the first section, and the Butterley Coal & Iron Co. that of Section No. 2.

C.E.A.

Pneumatic Tools and Appliances.

By EWART C. AMOS, M.I.MECH.E.

PNEUMATIC DRILLS AND THEIR APPLICATION.

(Continued from page 531.)

In the last article further reference was promised to pneumatic drills, and in view of the immense developments taking place in the application of this class of machine for work which hitherto had of necessity been done by hand, no apology is needed for describing further types. In fact, now that these machines are extensively getting into the hands of engineers, it is being rapidly discovered that they have uses considerably in advance of anything contemplated even by the inventors, and at the present time it is not too much to say that manufacturers are unable to adequately comply with the demand. Probably no other class of machine has received such wide and early appreciation by engineers generally. Coming now to a description of some further types, Fig. 76 shows a "Little Giant" breast drill, which is one of the lightest drills made, weighing only 8 lbs., and yet capable of drilling up to ½ in. full in steel, or will bore wood up to 1 in. diameter. It is also useful for screwing nuts on bolts, and many other purposes. It is of the 4-cylinder type, as described in the last article, and referred to under Figs. 61 to 75, but with a different system of valve gear. It will be remembered in that machine the cylinders were controlled by two piston valves worked by eccentrics on the crank shaft, whilst in this machine the valve is in the form of a disc fitted with suitable admission and exhaust ports, and is placed at the top of the machine. On admission of live air this valve automatically oscillates and controls admission to the cylinders alternately. The whole machine is made entirely of steel, and since all the working parts are encased it will sustain continued and compara-

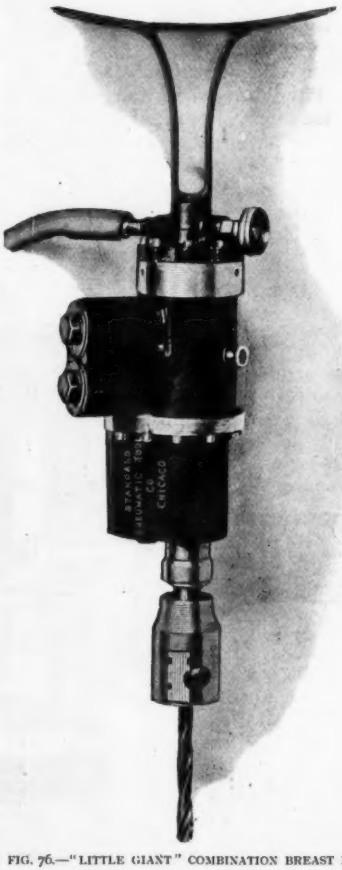


FIG. 76.—"LITTLE GIANT" COMBINATION BREAST DRILL.

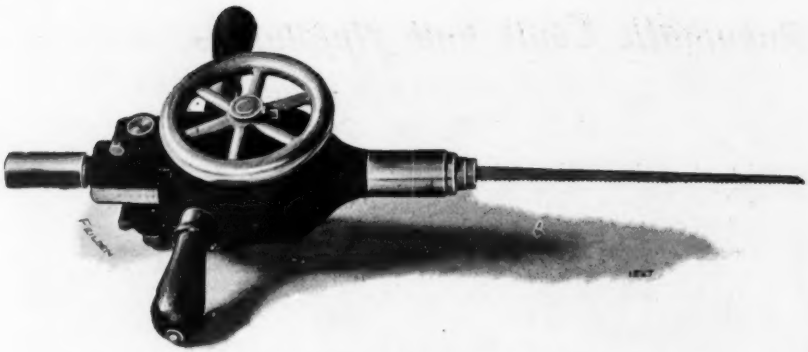


FIG. 77.—RECIPROCATING SAW, DRIVEN BY A "BOYER" MOTOR.

tively rough usage without danger. In place of the breast portion shown, a screw feed may be fitted when it is required to put greater pressure on the feed, or for light work a handle may be substituted. It is provided with compound gears for both fast and slow speed for large and small drilling, the change from one to the other being instantly effected by moving a small projecting pin. The machine, when working at its fullest capacity, requires 15 cubic feet of free air per minute. It is an exceedingly portable machine, and, considering its extreme lightness, has a large capacity.

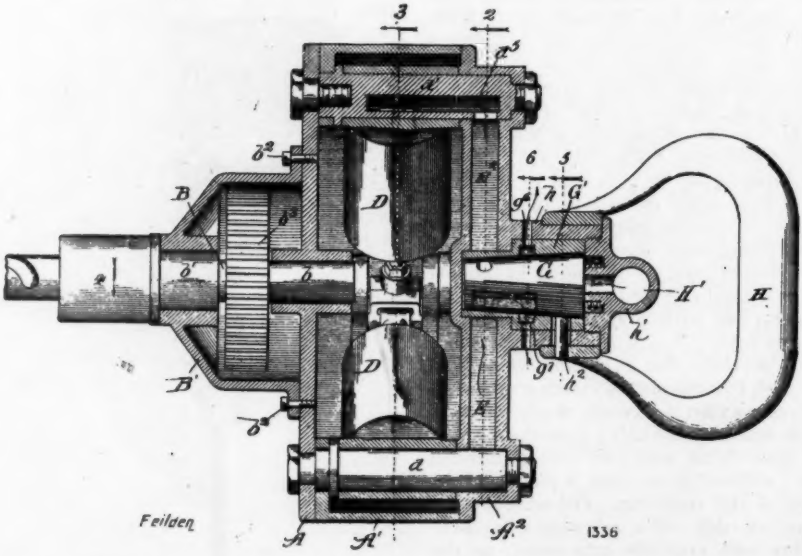


FIG. 78.—DRILL MOTOR SUITABLE FOR DRIVING CHAIN HOISTS, ETC. LONGITUDINAL SECTION.

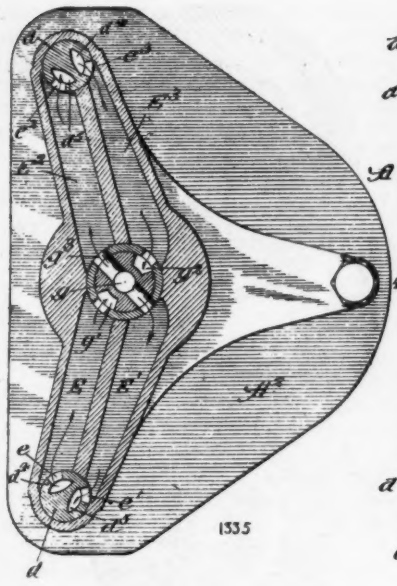


FIG. 79.

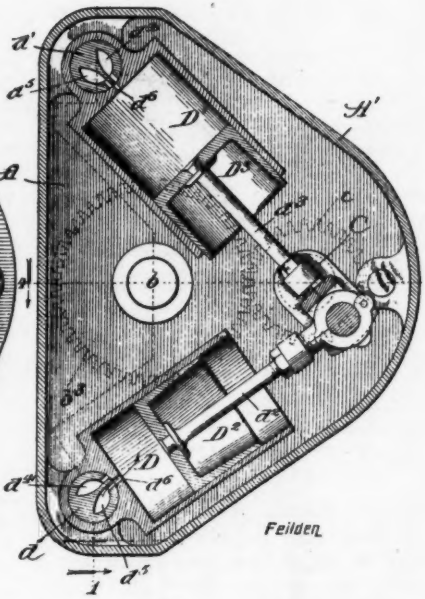


FIG. 80.

DRILL MOTOR: PLAN SECTIONAL VIEWS TAKEN ON LINES 2 AND 3 OF FIG. 78.

Fig. 77 shows a reciprocating saw driven by a "Boyer" motor; this is a somewhat novel application of a drill motor, and although not adapted for drilling, as generally understood, is referred to here on account of its being a motor of the type under consideration. In this machine the actuating mechanism consists of a single acting oscillating cylinder similar to that used in the "Boyer" breast drills. It is fitted with a trunk piston and connecting rod, which latter works directly on to a crank shaft, which when the motor is used as a drill becomes the drill spindle. When, however, applied for the purpose of driving a reciprocating or keyhole form of saw, as here illustrated, the crank shaft is fitted with another connecting rod attached to the saw blade, and supplied with suitable guides. It will, therefore, be at once understood how the oscillating cylinder produces a reciprocating motion on the saw blade. Such a machine is adapted for doing a great deal of work that has hitherto been done with an ordinary hand keyhole saw, and is likely to have extended application. Still another type of drill motor, also suitable for driving chain hoists, &c., is illustrated in section in Figs. 78 to 84. The chief feature in this machine is that it embodies a simple form of an oscillating cylinder engine in combination with an equally simple reversing arrangement, which is highly valuable for certain classes of drill work, and absolutely essential in connection with chain hoists.

In the drawings shown, Fig. 78 is a vertical longitudinal sectional elevation; Figs. 79 and 80 are plan sectional views, taken on lines 2 and 3 of Fig. 78; Fig. 81 is a longitudinal sectional view of a portion of the machine taken on the

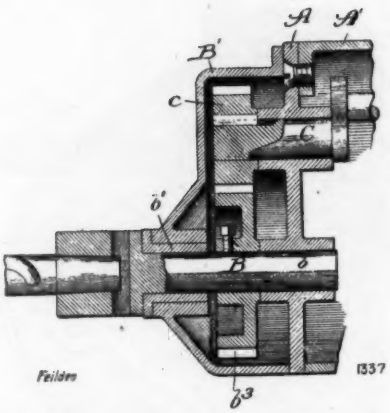
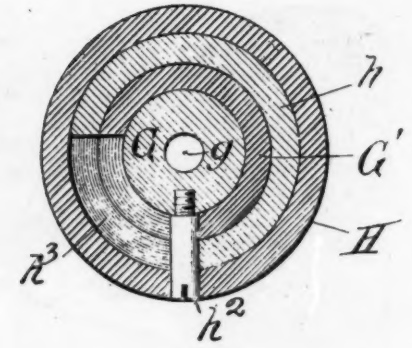
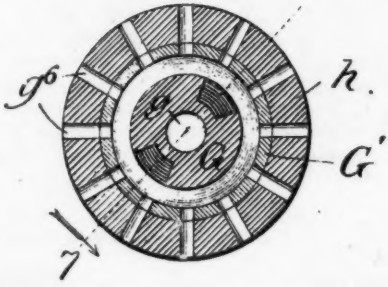
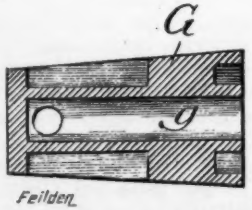


FIG. 81.—DRILL MOTOR: LONGITUDINAL SECTIONAL VIEW TAKEN ON LINE 4 OF FIG. 80.







FIGS. 82, 83 AND 84.—DRILL MOTOR: TRANSVERSE SECTIONAL VIEWS, TAKEN ON LINES 5 AND 6 OF FIG. 78, AND LONGITUDINAL SECTIONAL VIEW OF A PORTION OF THROTTLE VALVE.

line 4 of Fig. 80; Fig. 82 is a transverse sectional view taken on the line 5 of Fig. 78; Fig. 83 is a transverse sectional view, taken on the line 6 of Fig. 78; and Fig. 84 is a longitudinal sectional view of a portion of the throttle or main controlling valve.

The machine consists of a main casing made in three parts, viz., a base plate A, and intermediate casing A^1, and a cap A^2. An operating shaft B is provided and has one bearing b in the base of the casing, and its other bearing b^1 in a lower cap B^1 which is secured to the base plate by means of the screws b^2. To rotate this operating shaft, a crank shaft C is provided, which has its bearings arranged in the upper and lower parts of the main casing, and is provided with a spur pinion c which is attached to the lower end thereof, and which gears with a spur wheel b^3 on the operating shaft.

In order to rotate the crank shaft in either direction, two oscillating cylinders D and D^1 are provided and pivotally mounted upon pivotal valves d and d^1. Each of the oscillating cylinders is provided with reciprocating pistons D^2 and D^3, which have their piston rods d^2 and d^3 working direct on to the crank shaft. It will be observed from the above description and from the arrangement of the mechanism as shown in Fig. 80 that the impulse on the crank shaft is intermittent—that is,

the pistons act on the shaft alternately. In order to supply compressed air to the oscillating cylinders at the desired time, the pivotal valves d, d^1 are made of the usual hollow type, and provided with passages d^4 and d^5. These passages are provided with two transverse outlets arranged to be brought into alignment with the passages d^6 in the oscillating cylinders, so that pressure may be admitted to or exhausted from such cylinders at the proper time. In order to admit compressed air to the pivotal valves d, d^1, the upper cap of the main casing is provided with two sets of passages E, E^1, E^2, E^3, arranged in pairs, and which connect with the longitudinal passages in the pivotal valves d, d^1 by means of the transverse openings e, e^1, e^2 and e^3. In order to control the admission and exhaust of the compressed air to rotate the crank shaft in either direction, a main controlling or throttle valve is provided, which has a tapered plug G, having its seat in a bushing in the cap of the main casing and which is provided with a longitudinal and transverse inlet passage g and exhaust passages g^1 and g^2. The bushing G^1 in which this tapered plug is seated is provided with four transverse openings g^3 adapted to register with the transverse openings or passages in the plug.

To rotate the tapered plug of the main valve an oscillating handle H is provided, mounted on the outside of a hub h of the main casing cap. A flanged plug or nut h^1 assists to maintain this handle in its desired position, and is also provided with a main inlet H^1, through which the air is admitted to the longitudinal inlet opening of the main valve plug. A pin h^2 is inserted in the handle portion, and passed through a segmental slot h^3 in the hub of the cap and valve seat, and engages with the tapered plug of the main valve, so as to partially rotate the same by means of the handle whenever desired.

In operation, assuming the controlling throttle valve to be in the position shown in Fig. 79, compressed air passes through the main cap down through the inlet opening g of the tapered plug of the main valve into the passages E^1 and E^2 of the casing cap. The pressure continuing, flows through the passage d^5 of the pivotal valve d, out through the passage d^6 into the pressure cylinder D, to force its piston forwardly and assist in rotating the crank shaft. At the same time the oscillating cylinder D^1 is in such position that the further admission of air

FIG 85.—PAIR OF "LITTLE GIANT" CHAIN BLOCKS DRIVEN BY A PNEUMATIC MOTOR.

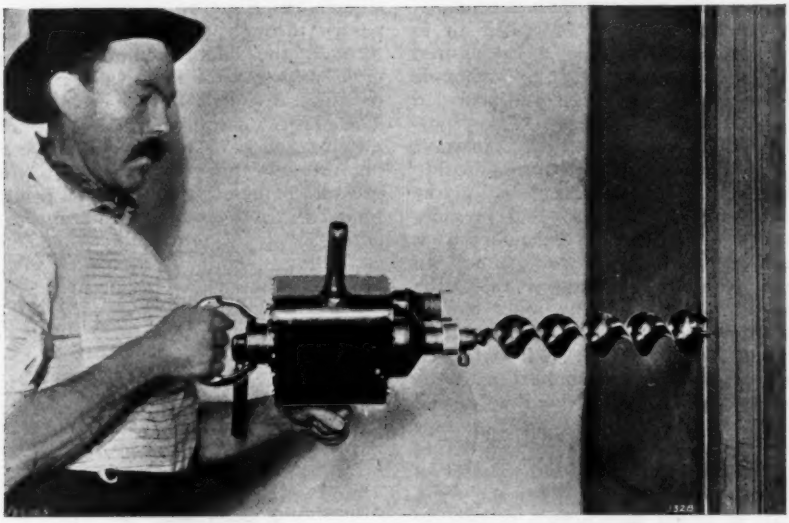


FIG. 86.—"LITTLE GIANT" DOUBLE SPINDLE REVERSIBLE BORING MACHINE.

has stopped. The further rotation of the crank shaft carries the parts to such position that the air passes out though its passage d^6 through the exhaust passage d^4 of the pivotal d^1, thence through the passage E^3 in the casing cap, or passage g^2 in the tapered plug of the main valve, and out through the opening g^6 in the valve casing. The crank shaft continuing its rotations, the oscillating cylinder D^1 is oscillated so as to shut off the exhaust and brings its passage g^6 into alignment with the transverse passage of the inlet passage d^5, in the pivotal valve d^1, so as to admit a supply of air from the supply channel E^2. At the same time the oscillating cylinder D has been carried into such position that its passage d^6 is brought into alignment with the exhaust passages d^4, e, E, g^1, g^7, to be exhausted into the open air.

If it is desired to reverse the rotation of the drill, the handle H is rotated so that its pin h^2 is brought to the opposite position to that shewn in Fig 82. This brings the passages in the tapered plug of the main valve one-fourth of the way round, so that what were the exhaust passages in the pivotal valves described during the previous operation, now become the inlet ports, and what were described as the inlet passages in the foregoing operation, now become the exhaust passages, thus permitting the parts to be rotated in a reverse direction.

Although the drawings shown refer to a drill having only two oscillating cylinders, yet these valves are equally operative with a double set of oscillating cylinders, that is, four in all, the second set being immediately below the first, the pivotal cylinder valves being, of course, prolonged to go through both sets.

As already pointed out, this form of motor lends itself very readily to the driving of chain hoists, and such an application is seen in Fig. 85, which shows a pair of "Little Giant" chain blocks driven by a pneumatic motor in

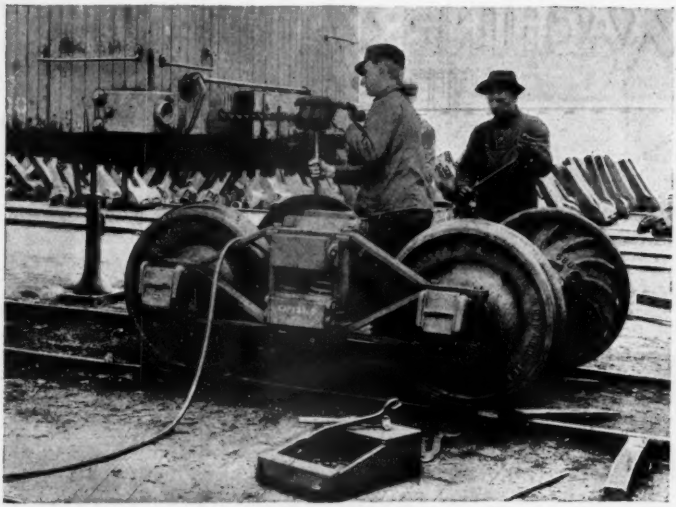


FIG 87.—"LITTLE GIANT" DRILL ON CAR WORK DOING HEAVY WOOD BORING.

use at the London and North Western Railway Co.'s Wolverton Works.

It is frequently desired to drill holes in confined spaces, or against projections, where it would not be possible to apply a pneumatic drill in the ordinary way, and in such cases a right angle attachment becomes a necessity. Such an arrangement will be shown in the next article.

Fig. 86 shews a "Little Giant" double spindle reversible boring machine, which can be reversed when running at full speed. For wood boring, a machine capable of reversing is highly essential, in order to withdraw screw feed augurs from the hole, whilst the double spindle arrangement provides for small boring at a high rate of speed, and the other spindle which is back-geared, is suitable for heavywork. No adjustment is required to change from one speed to another beyond moving the augur from one spindle to the other.

Fig. 87 shews a similar machine as applied to heavy wood boring on car work.

For flue rolling, or tube expanding, as it is more generally termed here, the pneumatic drill has an immense future. Fig. 88 illustrates a "Little Giant" reversible drill fitted with a tube expander. The machine can be driven in either direction by simply reversing the handle, and is stopped by placing the handle in centre position. Further reference will be made in the next article as to the rate of speed at which tubes can be expanded as compared with hand rolling.

(To be concluded in the next issue.)

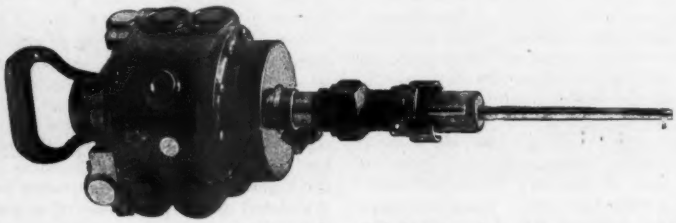


FIG. 88.—"LITTLE GIANT" TUBE EXPANDER.

Machinery Appliances and Processes.

"Every part and side of our life, from the cradle to the grave, has been touched and tended by the inventor and manufacturer. His works are as numberless as the sands of the sea, but the onward rush of Science and the Arts opens up new fields of discovery and enterprise as each day dawns. Let us choose here and there among thousands, and in choosing take the best as far as in us lies."

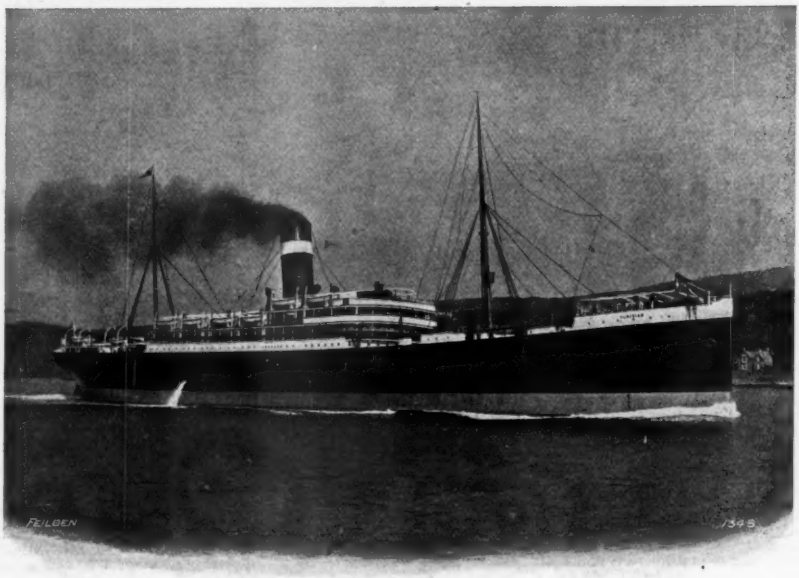
Recent Vessels.

THE JAPANESE BATTLESHIP, "ASAHI."

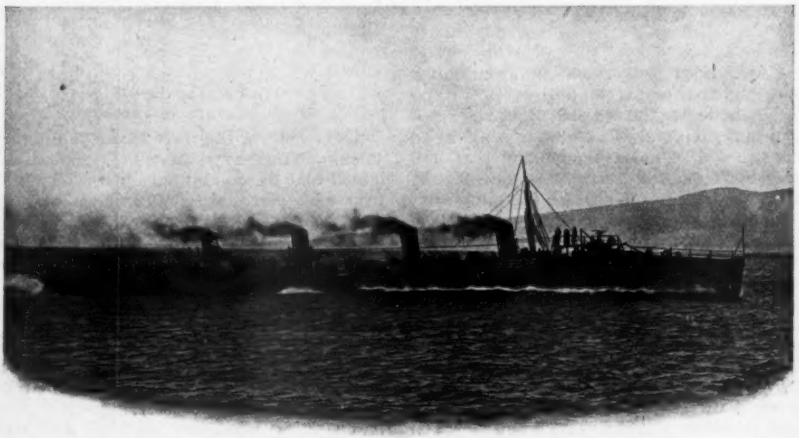
JOHN BROWN & CO., LIMITED, BUILDERS.

THE subject of the supplement plate in this issue is the largest battleship afloat at this moment, the *Asahi*, built by Messrs. John Brown and Co., at their Clydebank establishment, for the Imperial Japanese Navy. The speed trials terminated on March 26th, and we give in the following the general results, together with the essential data referring to the construction and the equipment of the vessel. The principal dimensions are: Length between perpendiculars, 400ft. 0in.; length over all, 425ft. 6in.; breadth, extreme, 75ft. 2½in.; depth, moulded, 43ft. 7½in.; normal mean draught of water, 27ft. 3in.; displacement, 15,200 tons; indicated horse-power, 15,000.

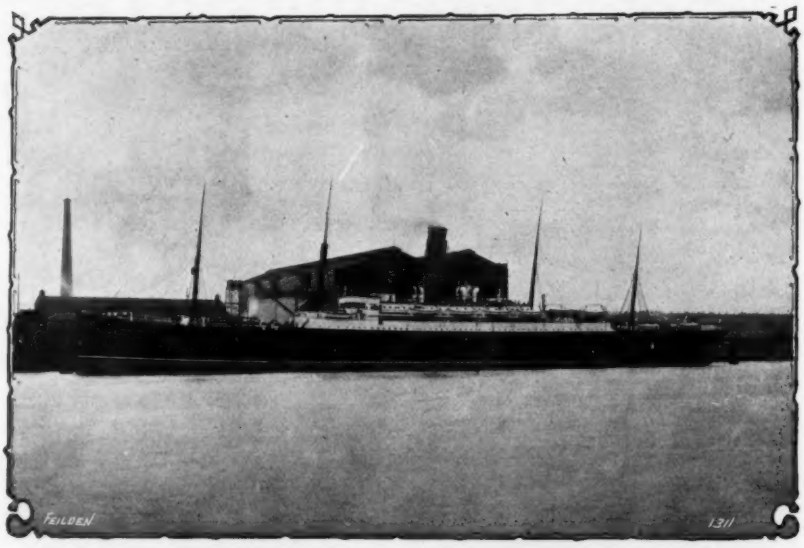
The chief armament consists of four 12-in. guns of the most modern type, mounted in pairs in two barbettes, one forward and the other aft. The manipulation of the machinery and all the operations of loading and laying the guns are performed by hydraulic power. The secondary armament consists of fourteen 6-in. quick-firing guns, each mounted in a separate casemate; twenty 12-pounder, eight 3-pounder, and four 2½-pounder quick-firing guns, with four submerged torpedo-tubes in two compartments, one forward and one aft. The whole of the protective material was manufactured by the builders at their Sheffield works, and is of the finest quality, every plate having been treated by the improved Harveyed nickel-steel process, except those for the conning tower, which, for technical reasons, are of ordinary Harveyed steel. There is a main belt, 250 ft. long, amidships with a total depth of 8 ft. 2 in.; when the ship is floating at the normal water-line, the lower edge will be 5 ft. 6 in. below water and the upper edge 2 ft. 8 in. above water. The maximum thickness is 9 in. Forward and aft of this main belt, the protection of the water-line region is completed by armour carried to the bow and stern. Above the main belt the sides from lower to main deck are covered with armour of a thickness of 6 in.; this belt also extends for a length of 250 ft., and, like the main belt, is completed by oblique traverses at the ends. As a protection against torpedo attacks, the vessel is furnished with a broadside net 300ft. in length, which, when not in use, is resting on a shelf running round the sides. The propulsion power of the ship is furnished by two sets of three-cylinder triple-expansion engines, developing 7,500 indicated horse-power each. The steam is furnished by 18 water-tube boilers of the Belleville economizer type, working at a pressure of 300 lbs., reduced to 250 lbs. in the engines. The *Asahi* left Portsmouth Harbour for the first time on Tuesday, March 20th, for the purpose of making a few low-speed trials on the measured mile. On the 21st of that month her coal consumption trial was made, showing that at 12,947 indicated horse-power the consumption only averaged 1·59 lb. per indicated horse-power. The full-speed trials were made two days later, on March 23rd, between Berry Head and Start Point, *i.e.*, over a distance of 12·25 knots. Although two of the four runs made took place in the teeth of a strong north-easterly gale, the average speed reached was 18·30 knots. This is a speed as fast as that of any of the battleships approaching the *Asahi* in size, and, taking this in connection with her large displacement, her builders deserve the highest credit, and Japan may be congratulated on the possession of so excellent a vessel.



THE ALLAN LINE TWIN-SCREW STEAMER "TUNISIAN." ALEXANDER STEPHEN AND SONS LINTHOUSE, BUILDERS.



THE RUSSIAN TORPEDO-BOAT DESTROYER "SOM." MESSRS. LAIRD BROTHERS, LTD., BIRKENHEAD, BUILDERS.



THE CUNARD TWIN-SCREW STEAMER "IVERNIA." MESSRS. SWAN AND HUNTER, WALLSEND, BUILDERS.

THE RUSSIAN TORPEDO-BOAT DESTROYER "SOM."

MESSRS. LAIRD BROTHERS, BIRKENHEAD, BUILDERS.

According to recent information, a great number of destroyers is to be added to the Russian Navy. Ten of 350 tons each and one of 240 tons are to be constructed almost immediately at the Nevski Works, St. Petersburg, one of 240 tons at the Ijora Works, in the same city, and seven of 240 tons each at Abo, in Finland. We publish to-day the reproduction of a photograph by Messrs. Robertson and Co., of Gourock, showing the torpedo-destroyer *Som* under full steam. This fine vessel, which was built and engined by Messrs. Laird Brothers, Birkenhead, gave very satisfactory results during its trials on the Clyde. According to contract, it was to develop, with bunkers full and all outfits and stores on board, a speed of 27 knots. This speed was much exceeded during her full speed trial (February 24th), and a speed of nearly 28 knots was developed as a mean of six runs on the measured mile, as is shown from the following data :

Miles.		Steam.	Time.	Speed.
1	...	225	2-11·2	27·44
2	...	228	2-10·4	27·61
3	...	223	2-7·0	28·35
4	...	219	2-8·8	27·95
5	...	215	2-9·8	27·73
6	...	210	2-12·0	27·27

The result for the three hours continuous steaming was 27·2 knots. It should be added that the conditions under which this trial took place were unfavourable, owing to a heavy sea and a strong S.W. breeze. There were present on the part of the Russian Government, Captain Ouspenski, Naval Attaché ; Captain Dobrovolski, Commander of the vessel ; Mr. Veshkowgov, Naval Architect ; and Mr. Petroff, Chief Inspecting Engineer. On February 28th and March 2nd a series of progressive trials at varying speed took place, and also trials to test the *Som's* steering, stopping, and starting efficiency, together with coal consumption trials. All these resulted in a complete success.

THE NEW CUNARD TWIN-SCREW STEAMER "IVERNIA."

MESSRS. SWAN AND HUNTER, WALLSEND, BUILDERS.

THE new Cunarder, of which we publish a photograph in this issue, is by far the largest steamship ever built on the north-east coast, and exceeds both the *Campania* and *Lucania* by 100 tons gross. She is not by any means the fastest of the ships of this Company, but her dimensions and the details of her construction render her one of the most interesting vessels afloat, as she promises to become one of the best dividend earners afloat. Her gross tonnage is 13,799 tons, and her displacement 25,000. The latter, therefore, exceeds by 9,800 tons that of the greatest battleship, the *Asahi* described above. She will carry 150 first, 200 second, and 1,840 third-class passengers, and her dimensions are as follows :—length, extreme, 600 ft.; beam, extreme, 64·6 ft.; depth moulded, to upper deck, 41·6 ft.; depth, moulded to shelter-deck, 49·6 ft. She has four complete steel-decks—lower, main, upper, and shelter—and also a steel orlop-deck from the boiler-room forward to the stem, while there is a bridge-deck 286 ft. long above the shelter-deck. The space between the orlop and lower deck is specially constructed for carrying chilled beef, and therefore well insulated, there are three refrigerating machines in a house on the upper deck, and a fourth, somewhat smaller, serving for the ship's own stores. Nearly the whole of the main deck is reserved for the use of the third-class passengers for whom there is also a covered promenade on the upper deck, also hospitals, a surgery, and a bar are provided besides; at the fore end of the bridge deck is a ladies' room on the starboard and a smoking-room on the port side. In addition to first-class cabins in the bridge, adjoining the main saloon, is a large deck-house above the bridge-deck giving accommodation for about 120 passengers. The remainder of the bridge-deck is fitted for the second-class, with their dining-room across the after end. The vessel is completely lighted by electricity. The engines, built by the Wallsend Slipway Company, consist of two sets of the quadruple expansion type, balanced on the Yarrow, Schlick and Tweedy system. They are fitted with Howden's forced draught, and have a working power of 210 lbs. to the square inch. The cylinders are 28½, 42, 58½, and 84 ins., and the stroke is 4·6 ft. The steam is supplied by nine single-ended boilers 15·6 ft. in diameter, and 12 ft. in length. The trial trip was very successful and the run from the Tyne to the Lizard Point was made in 41¼ hours. The speed developed on trial was 16¼ knots. The whole of the bunkers, doors, intercostals, &c., under engines and boilers were coated with Messrs. Wailes, Dove and Co's. patent "Bitumastic" enamels and so were the the tank tops.

It may be mentioned, as everything that refers to war has a certain interest at present, that if the *Ivernia* were chartered as a transport, she could accommodate 150 officers, 30 second-class, 2,000 troops, 800 horses, coal for 40 days at a speed of 15 knots, which would be sufficient to carry her out to Durban and home again without being obliged to coal on the way, and in addition she would have 12,000 tons of space for storage of ammunition, supplies, &c.

THE ALLAN LINER "TUNISIAN."

ALEXANDER STEPHEN AND SONS, LINTHOUSE, BUILDERS.

THE twin-screw steamer *Tunisian*, which was put into the water toward the end of March, is a sister ship of the *Bavarian*, but of a little greater power and accommodation. She is of the money-earning intermediate type, built for the Canadian trade of the Allan line, has room for a goodly number of passengers, and a large freight capacity, though her speed is merely moderate. Her gross tonnage is 10,576, she has a length of 520 ft. over all, 500 ft. between perpendiculars, 59 ft. beam, and a depth of 43 ft. The hull is of steel in conformity to the Board of Trade requirements for the foreign-going passenger steamers, and the construction and design have been under special survey, and with the scantlings required by the British corporation for its highest class. There is accommodation for not less than 200 first-class passengers provided in very large and airy rooms amidships, while abaft and below the saloon accommodation are rooms for 250 second-class passengers. At forward and after ends of the vessel there

are quarters for a large number of third-class passengers, being berthed mostly in four-berth rooms. How comfortable are even the arrangements for the steerage passengers may be seen from the fact that there is a reading-room for the women, and a smoking-room for the men. The propelling machinery furnished by the builders of the vessel consists of two sets of triple-expansion engines, each having three cylinders 27, 46, 76 ins. in diameter respectively, with a stroke of 54 ins. Steam is generated in six single-ended main boilers, 15 ft. 9 in. in diameter, and 12 ft. long, and one auxiliary boiler 14 ft. 6 ins. in diameter and 11 ft. 6 ins. long. The main boilers are fitted with Howden's forced draught, air being supplied to the furnaces by two of Howden's 95-in. fans. The auxiliary boiler is a natural draught boiler. The working pressure in all the boilers is 200 lbs. per square inch. The ship carries a Quiggin's patent evaporizer of sufficient capacity to evaporate 50 tons of salt water per day, and a Quiggin's patent filter for cleansing the feed-water. The lighting is throughout supplied by electricity, for which there are two independent sets of generators, each comprising an engine and a dynamo. Taking it all in all the *Tunisian* need fear no comparison with the best passenger steamers on the Atlantic, and she is the largest, fastest, and finest vessel belonging to the Allan Company. Her trial trip was highly successful. The course taken was round Holy Island and back. During the cruise the measured mile was run several times, when the highest speed registered was fully 17 knots, and the average speed nearly 17 knots.

COST OF STEAM RAISING IN WATER-TUBE BOILERS.

A FEW weeks ago a paper was read by Mr. Holliday on the Cost of Steam Raising, and in it, and during the discussion, a good deal was said about the combustion in water-tube boilers. Both Mr. Crompton and Mr. Miller advocated large combustion chambers and fire-brick screens or bridges.

There can be little doubt that, with all its advantages, the water-tube boiler is not so easy to work smokelessly as a Lancashire or return-tube boiler. The number of summonses against London electric light companies testifies eloquently to this fact. It may be of interest if a description be given of an arrangement of furnace which (as the result of a large number of experiments) has been found to answer the requirements of the case. The problem to be solved was the burning, practically smokelessly, of Midland coal in water-tube boilers of the Niclausse type. These boilers, with ordinary grates, when fired with Welsh coal, such as Mardy or Powell Duffryn, worked quite smokelessly, but with the Midland coal, of large size even, emitted clouds of black smoke. It was early evident that one thing necessary was to lower the fire-bars, as the longer flames of the softer coal reached the cold tubes before combustion was fairly started.

The lowering of the grates made a marked difference, but something else was required; and finally an arrangement was adopted, as shown in Figs. 1, 2, 3.

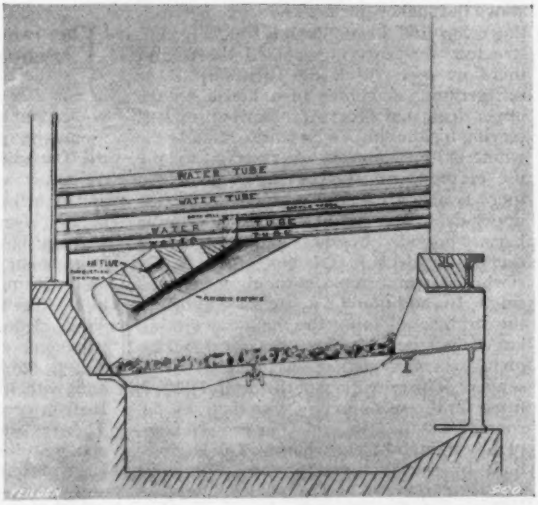


FIG 1.—STEAM RAISING IN WATER-TUBE BOILERS.

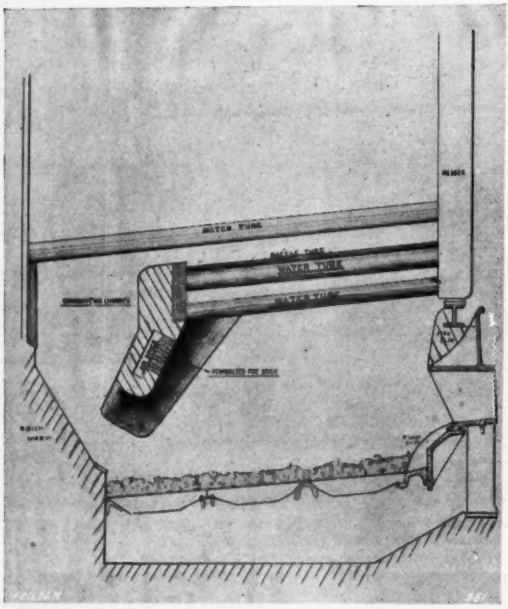


FIG 2.—STEAM RAISING IN WATER-TUBE BOILERS.

It will be seen that in the ordinary way the gases would pass directly up through the tubes, and with Welsh coal this is quite satisfactory. In this arrangement the gases are diverted and made to pass over the fire and sweep round the face of an arch and under it, through a comparatively small area, where they mix with air introduced through the arch, the space behind which forms a further combustion chamber for the gases before they impinge on the main body of the tubes. The arch is of peculiar form, being concave in two directions, viz., as viewed from the front and from below. This makes a very strong form, and numbers of these arches have worked for nine months without any repairs, and then only wanted the more exposed portions renewed. The effect on the combustion has been admirable, and instead of coal (Welsh) at practically £1 per ton, the boilers now use Midland coal at 9s. 6*d*., delivered at the boilers, the smoke nuisance being altogether abated. This means, even allowing for extra handling and lower evaporative power of this coal, a very large annual saving.

To effect this, it is necessary to fire the boilers as if done by a "Coking" stoker—that is, to put the fresh coal on in front and gradually push it back. A mechanical stoker does this admirably, but it is doubtful if it will respond quickly enough to the fluctuating demands for steam in an electric light station.

With Babcock and Wilcox boilers, so largely used in our central stations, the solution of the problem is even easier, as one can more readily get ample combustion chamber, and Fig. 4 shows the arrangement for such boilers. The excess air can be admitted by making the bridge hollow, as in Fig. 1, or by grids in the fire-doors. In practice there seems little to choose between the two methods, as air admitted in front is bound to mingle with the gases as they pass under the bridge.

In existing Babcock boilers it

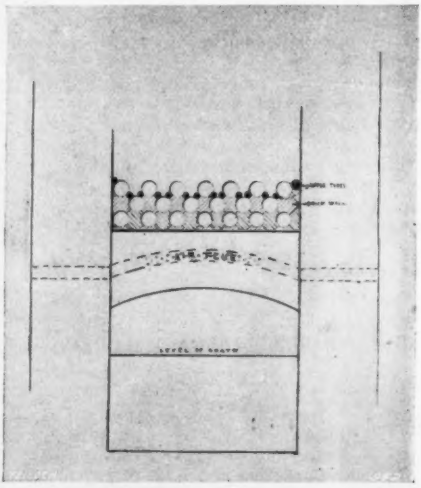
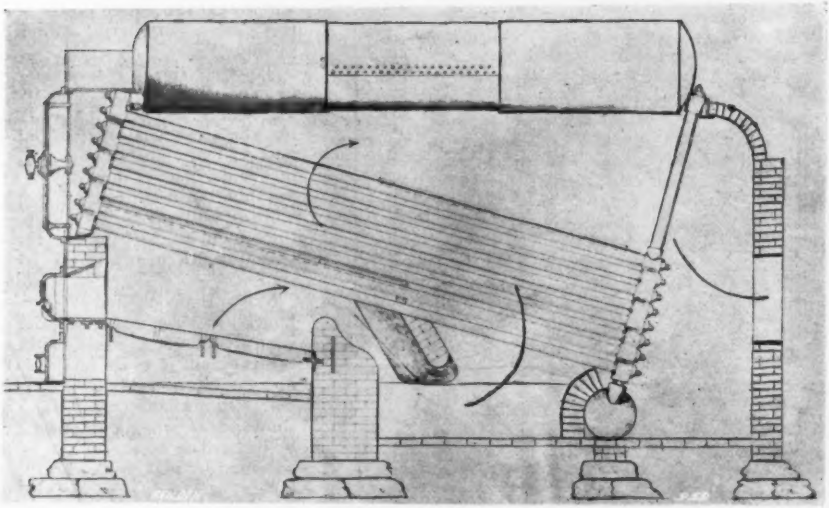


FIG 3.—STEAM RAISING IN WATER-TUBE BOILERS.



STEAM RAISING IN WATER-TUBE BOILERS.
FIG. 4.—THE ARRANGEMENT FOR BABCOCK AND WILCOX BOILERS.

is necessary to remove the original baffles, and put in baffle tubes where shown, but, by using a special form of baffle tube, this can be done without disturbing the water tubes.

These baffle tubes, contrary to expectation, give no trouble by buckling or perishing.

The furnaces have stood the test of very variable work and heavy forcing for more than two years and given no trouble, nor have the lower rows of tubes been distressed by the application of the device.

This grate is the invention of P. A. Low and W. Huskisson, and is patented by them jointly with Messrs. Willans and Robinson, Ltd., at whose Rugby Works the experiments were carried out.

THE "RAPID" MANUAL CHARGING MACHINE.

THOUGH manual labour in charging and drawing the retorts of the great metropolitan gas works has been largely superseded by either one or the other of the well-known mechanical systems, there still remain many gas works, of small or medium size, which do not afford the scope for such appliances. In the first place, the power of the machines would be far beyond the actual work they would have to perform; and, secondly, the cost of installation would be similarly out of proportion. Therefore most of these have been content to continue the old hand system, despite its acknowledged disadvantages.

Messrs. Biggs, Wall & Co., however, a well-known firm of London engineers, have lately devised an ingenious mechanical plant, which admirably fills the gap between the great charging appliances and purely manual hand-scoop or shovel charging. The machine is at once simple, efficient, and economical. It consists essentially of a drum worked by a chain wheel. To the drum is attached a steel-wire rope, or a chain, to the other end of which is fixed a cradle, which slides over the scoop containing the charge of coal. Upon the side of the drum there is a ratchet wheel and pawl which engages with it, by which the load can be suspended at any desired height.

The lifting gear, as described, is hung from a travelling carriage, which travels to and from the retort by means of two pairs of wheels on a double line of rails, whilst the carriage itself is so arranged that it travels on another set of rails fixed parallel to and in front of the retort bench, so as to enable it to deal with any number of settings of retorts.

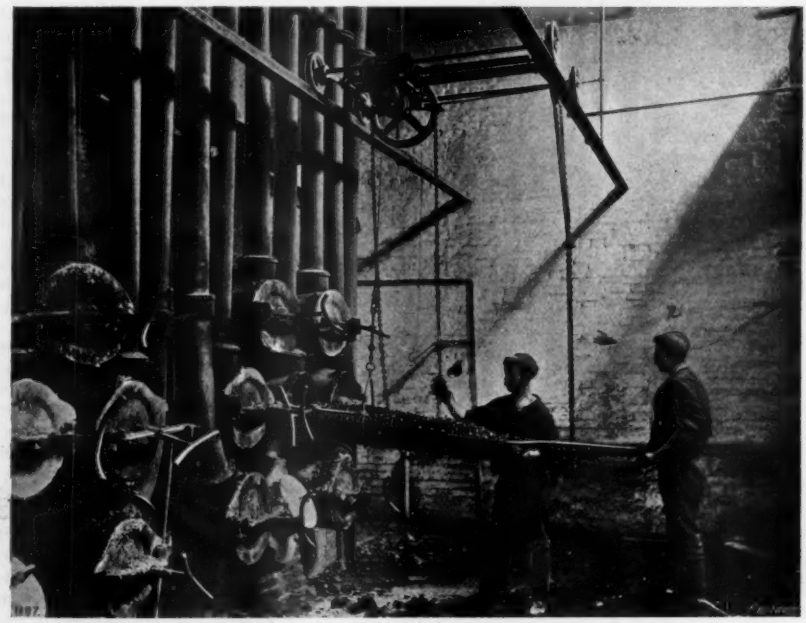
In working, the scoop resting in the carrier is filled with coal. Then the chain wheel is set at work, and the wire rope is fed over the drum. When the scoop is opposite the mouth of the retort, the scoop-driver "drives" the machine, and the impetus obtained by the 5-ft. travel of the lifting-gear carriage carries the scoop the full length of the retort, when it is turned and withdrawn for refilling.

The advantages attained by the employment of the "Rapid" Charging Machine may be summarised as a saving of labour, time, and consequent expense, seeing that the machine employs only two men, and these labourers may be unskilled. The retorts are better filled, resulting in an increased production of gas, and the very arduous and trying labour of the ordinary gas stoker is materially reduced. Stokers should welcome this machine as a great lightener of their heavy labour.

We note that all the principal working parts are made interchangeable, and these are supplied by the makers separately as desired. The time occupied in charging a 9-ft. retort with 4 cwt. of coal is only one minute, and this alone should recommend its adoption.

The makers state that in a few months hence they will have ready an arrangement for working this machine in a most novel manner by steam or other power at a comparatively small cost, by utilising any existing power on the works. This arrangement can be fitted without any alteration having to be effected in the machine.

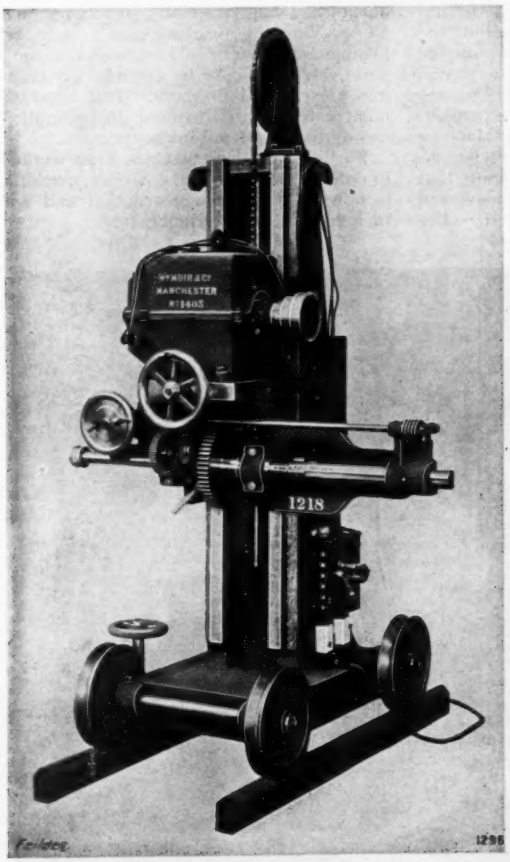
Further, a drawing machine, to be worked in conjunction with the charging machine, is now in course of construction, and will be a very valuable adjunct.



MESSRS. BIGGS, WALL AND CO'S. MANUAL CHARGING MACHINE.

DRILLING AND BORING MACHINE.

THE subjoined illustration represents a special Horizontal Drilling and Boring Machine, constructed by Wm. Muir and Co., Ltd., the well-known machine-tool makers. The power is furnished by a self-contained electric motor furnishing 1½ h.p. and suited for a direct current of from 220 to 250 volts. The construction of this useful tool is simple and efficient. A standard, or upright, carrying the spindle slide is mounted on four grooved wheels, which move the drill along the tram-rails and is furnished with a locking handle, as seen in photograph, which secures this drill in position. The spindle slide is balanced and adjustable and the diameter of the spindle itself is 1⅛ in., the latter having a vertical traverse of 3 ft. 4 in. The machine is specially adapted for drilling holes in locomotive frames up to ⅞ in. and in depth up to 1 ft.



DRILLING AND BORING MACHINE BY MESSRS. MUIR AND CO., MANCHESTER.

IMPROVEMENTS IN WEAVING.

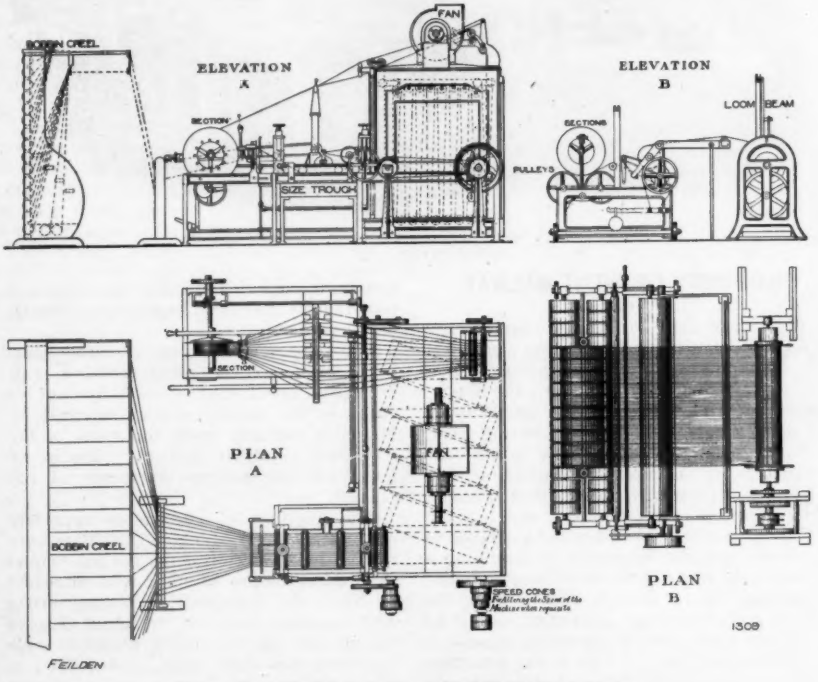
THE improvements in weaving we are dealing with are concerned with sectional warping, sizing, drying and beaming machines. It is claimed that in conjunction with the new warp beaming frame, these improvements are applicable to any machines already in use. By the system at present described, any unevenness in the length of the threads in different sections is avoided, and the lengths rendered as even as possible, having regard to the circumstance that woollen and worsted threads are more or less elastic. The degree of uniformity thus obtained results in the avoidance of those tight and slack places which produce marks and streaks in the cloth when woven, with the result that a superior product is obtained.

The output of the loom is stated to be considerably increased through the regularity of the warp threads and their freedom from clogging and gumming in sizing by the system of warping, sizing and air drying invented by Mr. W. Bywater and illustrated on pages 657 and 658. Each thread being kept separate, and the hot air in the chamber being continually exhausted by a fan, the tendency of the threads to become gummed to each other,

so prevalent in the old methods of working, is obviated, and the work of the weaver greatly facilitated.

The warp threads are stretched on flange sections or "cheeses," and are transferred to the beaming frame in the method shown in the illustrations. In this frame the sections rest upon two rollers, with grooves to accommodate the flanges, so that the threads alone rest upon the rollers. The employment of venetians are concerned, there is always a tendency for the cloth to work up "streaky," but with the employment of the system under notice, this tendency is reduced to its absolute minimum.

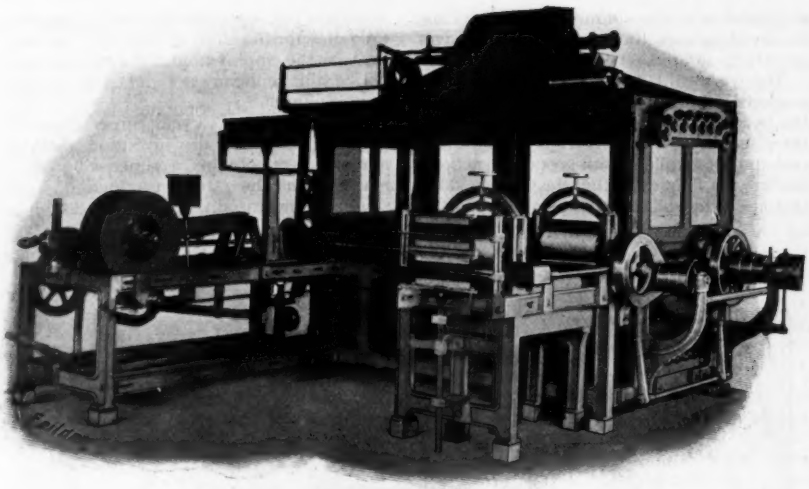
W. Bywater, of Sweet Street Foundry, Leeds, claims for his invention that the manufacturer obtains a superior product, inasmuch as the rate of production is substantially increased. The same length of



DETAILS OF AIR-DRYING CHAMBER AND PATENT BEAMING MACHINE

this principle renders the delivery uniform from the respective sections, the tension of the threads being adjusted and equalised by a tension bar as they are wound round the beam.

The mechanism is stated to be free from any complications that would entail any risk of its getting out of order. In some cases, of course, such as those where satins and warp is wound upon each section, the machine stopping automatically. The sections are placed on the face of the pulleys of the beaming machine, which are all turned to exactly an equal circumference, so that in winding a beam, the warp on the sections is delivered to the beam at the same tension. The result is that a perfect beam is made without any waste of warp.



BYWATER'S AIR-DRYING CHAMBER AND PATENT BEAMING MACHINE.

HALFORD'S GRADIENT RAILWAY.

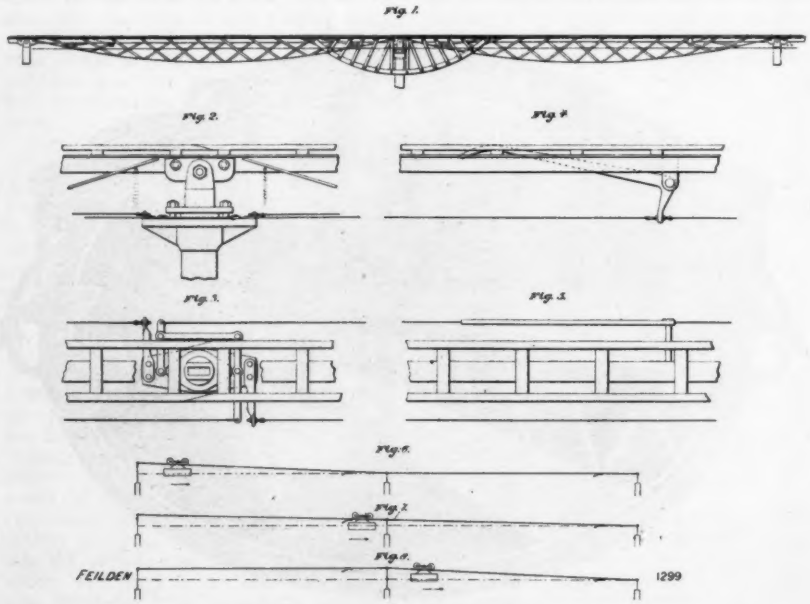
A GREAT deal of public notice has recently been attracted by a practical application of the suspension system of railway cars, represented by the Single-Rail Suspended Railway in the Wupper Valley, Germany. This interesting road of the "Langen" type, now under construction, is to have a length of 13·3 kilometres (8¼ miles), running from Barmen *viâ* Elberfeld and Vohurnkel, and is being built at an estimated cost of from 450,000 to 500,000 mk. per kilometre, or, assuming a train to be dispatched every three minutes, carrying on an average 100 persons, the total cost, including equipment, would be 700,000 marks per kilometre (£35,000) or £56,000 per mile. This is far less than the average cost of other electric railways, since the Berlin Electric Elevated Line has cost three times as much to build, and the expenditure for the London Suburban Lines has been from four to eleven times as high. Should this single-rail suspended railway prove as successful as several shorter stretches of the same pattern have proved in mountainous districts of Germany, there will, no doubt, be a great demand in time for this novel type of locomotion; and even before the Wupper Valley line has been completed, another line of the "Langen" system, though of a modified type, being a rope-railway, has been begun at Loschurtz, near Dresden.

The most original application, however, of the suspended car-system, and one that, as regards speed of locomotion, has not its equal, is the railway system patented by Mr. H. S. Halford, under the name of the "Halford Gradient Railway," which we introduce herewith to the notice of our readers.

The question of speed is an important one nowadays, for, although the steam locomotive in its performance has left behind the wildest dreams of those who witnessed its birth, the constantly increasing urban and suburban traffic of the great cities of the present age is making demands upon transportation that steam power, used in the ordinary way at least, can no longer satisfy, nor is it likely to do so in the future, for the steam-locomotive has almost reached the limits of its capacity. Electric tramways and railways are gradually, but slowly, superseding the ancient steam railways wherever speed is of paramount importance, and at this stage of their evolution it is not yet possible to foretell to what ultimate efficiency these electric lines may be developed; both steam and electric railways, however, have that in common, that the motors are more or less complicated in

construction, and, however carefully balanced their several parts may be, the wear and tear of the revolving portions is considerable. One of the most important features of Mr. Halford's railway, therefore, is the absence of revolving and travelling motors, instead of which in his system the motion of the cars is caused by merely raising, as long as this is required, to a slight incline the section of track upon which they are running; thus endowing them with an ever-increasing velocity, which, theoretically, is unlimited, and, practically, may be permitted to reach a degree quite inadmissible on any ordinary track where the centre of gravity is situated above the cars. This will be clear from the following description of Mr. Halford's system :

The track of his railway, from which the cars are suspended, rests upon supports which can be raised and lowered by hydraulic rams, and is divided into sections which, although firmly secured to each other, are jointed so as to form, in a normal position, a flush joint. Being, however, joined together by a pin passing through an elongated hole at the end of the girders, sufficient play is allowed for a slight sliding motion of one end or the other, and each section may, at the desired moment, be raised to a slight incline sufficient to cause the cars suspended from it to glide towards the lower end by the mere force of gravity. The raising of the various sections in succession is performed by the carriage in its passage automatically opening the valves supplying the hydraulic rams, permitting the water to enter and exercise its upward pressure ; while in the same automatic manner the level of each section is restored after the cars have passed over to the next section. The devices suitable for that purpose are numerous. In his patent specifications the inventor first describes a method by which the cars, upon reaching the juncture of two sections, by their own weight press down a spring, which, being connected with a piston-rod, opens the passage for the water into the compression cylinder, driving upward the piston supporting the end of the rail ; but he afterwards gives an outline of a method by which the raising of the track is operated at will from the car by electricity, etc. Al-



DETAILS OF HALFORD'S GRADIENT RAILWAY.

though hydraulic power is that mentioned in the patent, and, for the present, has been selected by the inventor, since it can be conveyed over great distances with comparatively little loss; any other power, of course, will answer, provided it is capable of lifting the various sections of the track to the desired incline. The essence of the invention, however, is not the use of water-power, nor the suspension of cars—which is no longer a novelty—but the idea of using gravity as the motive power and thus giving to the cars an impetus which, in agreement with the laws controlling this force, is steadily increasing with each succeeding section traversed.

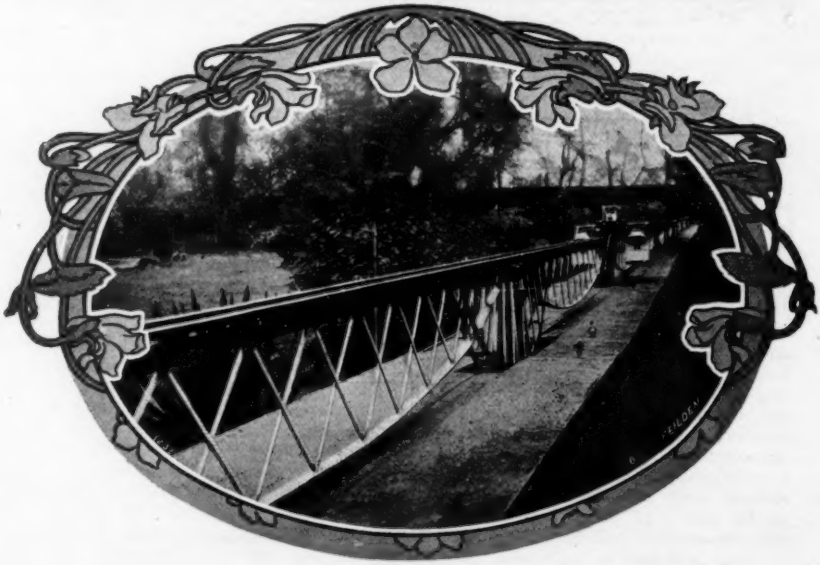
In the elegant model which Mr. Halford has constructed for himself, to illustrate the practical working of his invention—and which in the finish of some of its details shows the great mechanical skill of Mr. R. C. Faulkner, of Bedford & Co., of 95, Shaftesbury Avenue, W.C., well-famed among London model-makers—the track is divided into sections of 24 feet each, which are raised successively to a gradient in each case of 1 in 72 feet. Each section weighs about 100lbs., while the cars have a weight of 47lbs., and the water-power to lift the loaded sections exercises a pressure of 50lbs. per square inch, conveyed by means of rams having a diameter of $2\frac{1}{8}$in.

In the centre of each section is a supporting cylinder which takes the weight of the section so that the raising rams have little more to do than raise the weight of the cars.

Only one of these is used for the support of each section in the model, but, of course, their number may be increased, and it may be here mentioned that sections of almost any span can be made up of girders of standard length supported at their ends in raising rams, which would rise proportionately.

Assuming that in a full-sized line each section has a length of a fourth of a mile, the weight to be lifted would, of course, be considerable and might thus be distributed; still, this weight should offer no great difficulty when it is borne in mind that a pressure of 1,000lbs. per inch is commonly employed in hydraulics.

The increase of speed during the progress of the cars over a certain length of line is



GENERAL VIEW OF HALFORD'S GRADIENT RAILWAY.

indicated by the following experimental data:

Number of Section.	Time Consumed by Passing of Cars.
Starting Section	8 seconds.
Second "	6 "
Third "	4½ "
Fourth "	3½ "
Fifth "	2⅝ "
Sixth "	2 "

At first one might imagine the transfer of cars from section to section would be felt somewhat unpleasantly, as a kind of switch-back motion; this, however, is not the case, as the hydraulic rams move very smoothly and the gradient required is so small and so gradually produced that the lifting motion can be scarcely perceived. In the model, in fact, it appears as if the cars were running in an almost perfectly horizontal line. There is also no difficulty in stopping or re-starting the trains, which is effected by moving a lever in the driver's trolley, which either causes or prevents the lifting of the track, while the gradual application of powerful brakes brings the train to a standstill. Moreover, it is an important feature of Mr. Halford's device that the valves of the hydraulic rams can be opened at will from the car without any contact being required, no matter what the speed of the train should be at the given moment. When sufficient speed has been reached the driver pulls back his lever and the track remains level.

How gradual is the rise of the rams is shown in the diagrams accompanying this article, where the relative height of the track at three successive stages is indicated in Figs. 6, 7 and 8. If the cars were running on top of the rails, as in ordinary railway systems, the increase of speed caused by the uninterrupted fall of the weight of the train would soon have to be counteracted to prevent the cars leaving the rails; but as Mr. Halford has selected a suspension system in which the centre of gravity lies below the track, a speed many times as great as that of our fastest steam-propelled trains remains consistent with safety. It should not be difficult to render Mr. Halford's device useful in many ways, for the following reasons:—(1) In all other systems the greater the load, the *less* the speed. In this the greater the load the *more* the speed. (2) There is no need to stop for coal or water. (3) Its natural tendency must be to increase in speed.

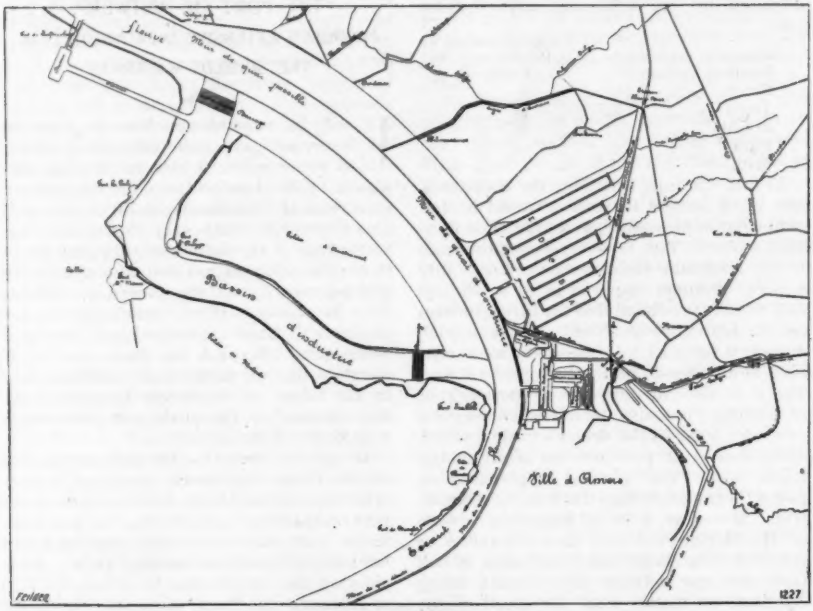
THE PORT OF ANTWERP.

PROPOSED EXTENSIVE IMPROVEMENTS IN THE SCHELDT WATERWAY.

It will be remembered that, in a recent issue, we gave some interesting details of the electric hydraulic dredge designed by Mr. Lindon Bates for the Russian Government, constituting in all its essential characteristics what may be almost described as a revolution in dredging practice. Founded on, yet embodying material improvements on, the American dredge *Bela* Mr. Lindon Bates first designed, that engineer's latest creation has attracted widespread attention, for there can be no question that the Bates dredges will possess in the future an important bearing on the development of the ports and commercial waterways of the world.

It appears likely that the next application of the Bates high-power dredging system, after that of the Volga, will be made at the port of Antwerp, in improving the waterway to the Port, and incidentally creating a new land area of great commercial value. Considering the vicissitudes to which the Port of Antwerp has been subjected during the period of its past history, through defective navigation facilities, it would be thought that the scheme advocated by Mr. Lindon Bates, having occupied the attention of the most eminent contemporary hydraulic engineers for a considerable period and received their unanimous approval, would not afford any basis for polemical discussion. The scheme of what is currently known as *La Grande Coupure*, however, has been adopted by the Antwerp Government, and, like almost all large questions under a representative government, has become a political one. It is to be trusted that the natural good sense of the citizens of Antwerp will induce them to take out of the range of mere party dispute a subject of such vital import to the prosperity of their City, and enable a project of a most interesting character to be entered on and carried out undisturbed by the interpolation of side issues.

Although the river Scheldt, generally speaking, is navigable even to the greatest liners, its condition, especially in the bend taken by the river immediately below the city, is such as to warrant serious apprehensions as to the future of the port. Between 1894 and



PLAN SHEWING MR. LINDON BATES' SCHEME.

1897 very extensive dredgings had to be carried on continually, to keep open a waterway of 25 ft. depth, and while these were in progress the Government was led to give renewed consideration to a project dating back as far as 1874. This was a plan proposed by the Belgian hydrographer, Stessels, for rectifying the bed of the river between Lillo and Antwerp. This project was reported on favourably by eminent engineers at different times, and as it affected the question of the Antwerp fortifications, it was submitted to General Brialmont, who likewise approved of it from this point of view. The cost of the undertaking, however, was estimated at £4,000,000, and the time required for its execution at ten years, and the result was that the undertaking was not proceeded with. In 1893, the urgent demand for quay extension reopened the question of rectification, and the Government consulted Mr. Franzius, the great German hydraulic engineer, whose work in rectifying the Weser entitled him to be considered the first authority in Europe. He approved in principle the Stessels-Brialmont project, but chose a slightly different line for the cutting which was to replace the objectionable bend in the river, chiefly for the sake of saving the American Basin.

While the Government accepted this proposal as representing the latest experience in hydraulic engineering, it did not identify itself definitely with the "Grande Coupure," and as the mechanical devices for executing the work had not been improved in the period intervening between the several reports to such an extent as to reduce materially the cost of construction, the matter had again to be left in suspense.

Such was still the state of affairs in 1896. At that time Mr. Lindon W. Bates was invited to submit proposals for a scheme based generally on the lines of the "Grande Coupure." This invitation was in a large measure due to the fact that Mr. Bates had brought high-power dredging plant to a state of efficiency which, as he claimed, would reduce the cost of the undertaking and the time required for it very materially.

His scheme, which was presented to the

Ministry in October, 1896, followed in principle the previous "Grande Coupure" projects, but, for several reasons, a somewhat different curve was chosen. The new line, shown on the plan, preserves as much as practicable of the existing basins, &c., and the method chosen, which includes filling in and reclaiming a large area with the spoil taken from the river, would create new properties of great value without entailing any interruption or obstruction of navigation during its execution. While the project, therefore, was nominally still the "Grande Coupure," it had become a proposal capable of being profitably and rapidly realised, instead of an academic exercise in hydraulic engineering on a large scale. The instruments proposed were to be hydraulic dredges of high power, operated from a central station on shore. The station was to be of 10,000 h.p. capable of operating a fleet consisting of two dredges of 3,000 h.p. each, one of 1,500 and three of 500 each. A method was prepared for building the quay walls electrically, and for performing virtually all operations from the one source of power. The material taken from the cut, unutilised under other designs, was to fill in and create land aggregating one-fifth the size of the city itself and appraised at its lowest at £2,000,000.

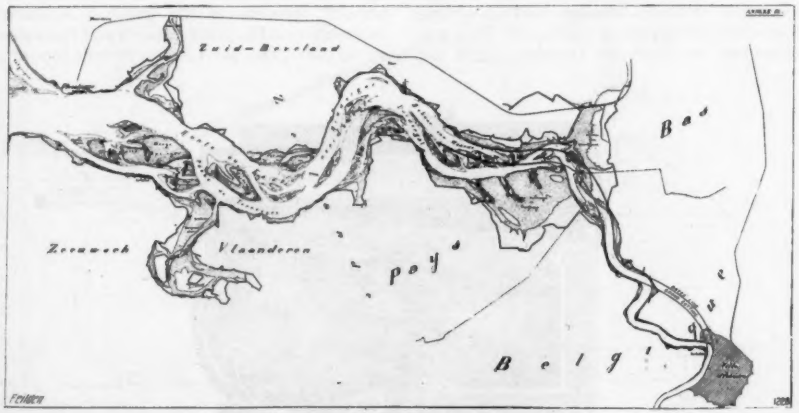
Mr. Bates also made several propositions for the execution of the work to the Government, by one of which he engaged to complete the cutting for £1,520,000 in two years after the completion of the plant, &c.

These figures will show strikingly how much the methods of working had been improved since the "Grande Coupure" was first considered.

As the view to be taken of this new scheme naturally depended a great deal on the performance of the type of dredge which Mr. Bates intended to apply, the Government appointed a Commission to examine his great dredge *Beta*, which had then made its record on the Mississippi. This Commission published a report in April, 1897, which concluded with the following words :—

"It would, without doubt, be easy for Mr. Bates, whose reputation as a designer rests on the testimony of the best qualified men in the United States, to construct a second edition of the *Beta*, free from the defects of the first, and capable of performing in suitable soil rapid, economical, and extensive work."

After the publication of this report, the Minister of Public Work instructed M. Pierrot, Engineer-in-Chief of the Scheldt, to submit Mr. Bates' proposal to Mr. Franzius. This was done, and Mr. Franzius approved entirely of the Bates line. In the summer of 1898, the Minister announced publicly the intention of the Government to execute the "Grande Coupure" in the interests of the commerce of Antwerp. From this time the



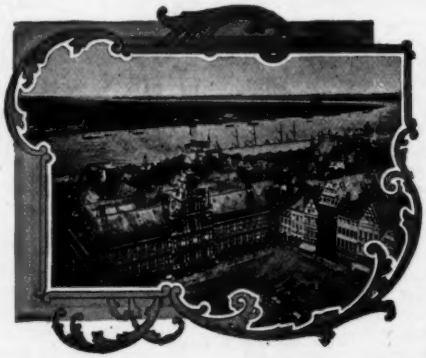
PLAN SHEWING M. PIERROT'S SCHEME.

question, as we have already stated, has become one of politics quite as much as of engineering, but the objections raised by the opposition to the merits of the project may be summarised thus: That a rectification of the old bed would do the work, that the cutting would be an experiment whose results nobody could foresee, and that the old bed could not be isolated as rapidly as was necessary for safety.

In view of this energetic resistance to the Government proposal, the Minister decided to submit the question to a further and final Commission, composed of the leading hydraulic engineers of Belgium. In the meantime, a considerable addition to the Bates project had been made. While the latter, like all the previous proposals, concerned itself only with remedying the evils caused by the big bend below Antwerp, the new scheme extended the Bates line, which it adopted entirely, a considerable distance down stream, as far as Bath. M. Pierrot, the originator of this new scheme, also increased the quay facilities and extended the system of basins. The method of execution was to be still that proposed by Mr. Bates, but the quantities to be excavated had been increased by nearly 70 per cent. The Commission decided in principle to recommend the whole improvement, and, in September, 1898, asked Mr. Bates to meet them in consultation on one point. The city authorities were apprehensive that it would be difficult to isolate the old bed as rapidly as was thought desirable, and they therefore desired a detailed design and a strong guarantee in support of the same. This was presented to them in October, and the guarantee given by the celebrated Société John Cockerill.

The Société Cockerill had an excellent opportunity of studying the merits of Mr. Bates' proposals, they having obtained from him a contract for the construction of a large dredge for the Russian Government in 1897, and at the time of the Commission this work was in an advanced state. This dredger was described in our March issue, and is now the largest dredging plant afloat. Extensive tests with it were made on trial grounds provided by the Belgian Government, in the presence of technical delegates from the Belgian and Russian Governments, and numerous other experts. The dredge not only exceeded the specified capacity by about 75 per cent., but the great facility in handling the plant, due to the electrical driving arrangements, was very strikingly demonstrated. These trials—almost on the actual site of the proposed new works—have entirely justified the forecast of the Belgian reporters on the Mississippi dredge, and demonstrated the eminent fitness of this dredging system for executing work of such magnitude as that contemplated on the Scheldt.

Since these trials took place, a new Municipal Election at Antwerp has resulted in further strengthening the Liberal majority, and consequently the opposition to the Government project of the "Grand Coupure." It is hardly to be supposed, however, that an opposition raised on grounds more or less factious can prevail against the deliberately formed and expressed opinions of the greatest available authorities on the practicability and the value of the enterprise Mr. Lindon Bates proposes.



WORKSHOP PRACTICE

The purport of this section of FEILDEN'S MAGAZINE is to give the skilled mechanic in our great industrial establishments an opportunity of bringing his practical ideas and experience into print. Inventive capacity and careful thought on the part of the workman is what we desire to encourage and foster. To this end we invite skilled mechanics, foremen, under-foremen, and heads of departments, to communicate practical suggestions, which, if accepted, will be suitably paid for. Wherever possible, drawings should accompany the contribution; rough sketches will suffice, as, when draughtsmanship is at fault, we will do all that is necessary to render them fit for reproduction. Nothing will be too poor for a careful inspection. It will be seen that those contributions which appear in this section show distinct merit, and are both interesting and instructive.

Driving a Planer with a Quarter-Twist Belt.—At the close of the engineering struggle many firms found themselves almost overwhelmed with work and at their wits' end to get it done. The shops were put on overtime, and in many cases, night shifts were employed. This resort was found necessary at a certain shop in the north of England. It was then found that one of the shops often had its engine running all night, almost solely for the sake of a 15-foot long Planer, the services of which could not possibly be dispensed with. It so happened that in another shop there was a space into which the Planer could be put, but then the difficulty was—how to drive it? The machine was of the old type, driven from a shaft parallel to the cross-slide, but in the desired new position, the driving shaft would be at right angles to the cross-slide. It would be an expensive expedient to turn the pulley shaft and its belt motion through a quarter-circle and drive through bevel gear; besides, neither the time of the fitters nor of the machine itself could be spared for a job of that sort. After viewing the situation for some time the happy thought arose to try and drive the machine with a quarter-twist belt, and so the machine was shifted and put down again as shown in plan and elevation in Figs. 1 and 2. The

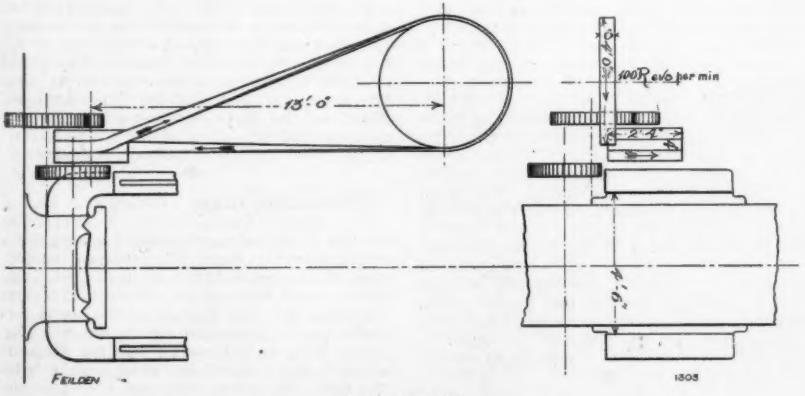


FIG. 2. DRIVING A PLANER. FIG. 1.

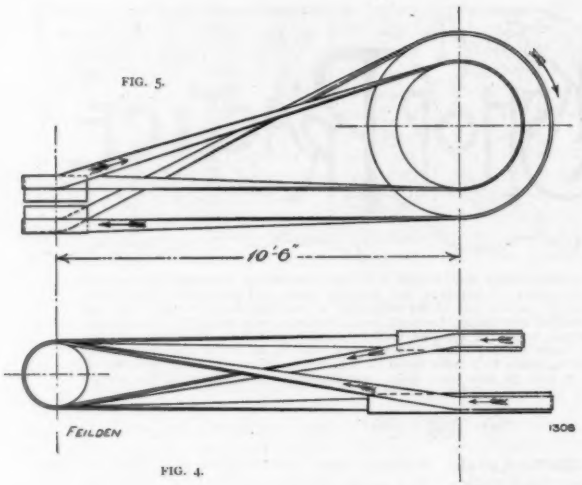


FIG. 4.

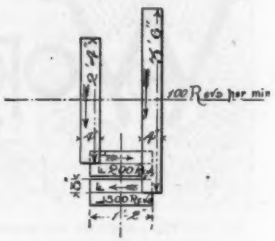


FIG. 3.

DRIVING A PLANER.

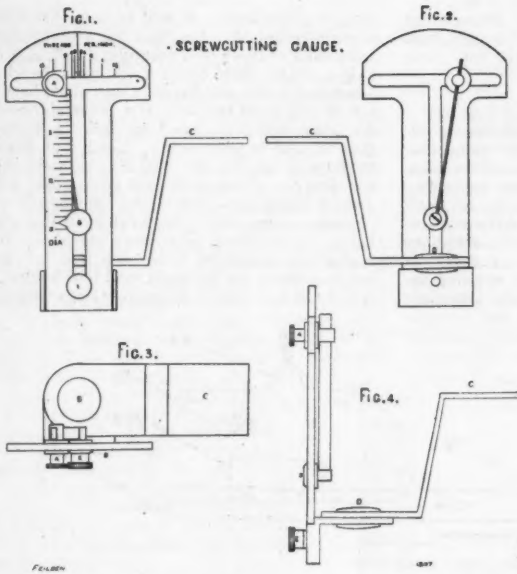
machine was driven by one belt shifting over three pullies, the travel of the table being reversed through gearing. Previous experience led to the assurance of the machine driving with the belt on the middle pulley, but the doubt was whether it would drive equally well when thrown 4 inches on either side of its theoretical path. It may interest your readers to know that the machine works in a most satisfactory manner, and thus, without any alteration except the bending of a belt fork or two, and with scarcely any stoppage of work, the machine was put into its new position, and driven from a shaft at right angles to its former driving shaft. Even the drum which drove it in the old position was found to be suitable for driving it in the new position. As stated above, the Planer had its table returned at a higher rate than the cutting stroke by means of gearing, but the following is a way of reversing by means of quarter-twist belts, by which a quick return of 1½ to 1 was obtained. This method is illustrated in Figs. 3, 4 and 5. The small pullies drove a horizontal screw compressor, and in arranging the position of the latter in the shop it seemed as if the lay shaft would have to be carried round a corner by means of mitre gear. However, the difficulty was got over by placing the drums and pullies in the positions shown in plan view, Fig. 3, and Figs. 4 and 5 show how the belts were arranged.

H. BICKERDIKE.

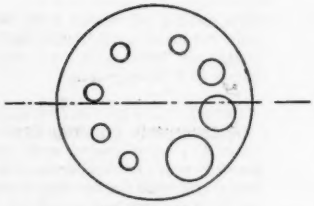
To Produce a Brilliant or Dead Black on all kinds of brasswork, take a quarter of a pound of carbonate of copper in about a pint to a quart of clean water, dissolve the carbonate (in the water), and next get about a pint of liquid ammonia ; now add the ammonia very gently to the copper, till the precipitate which is formed is redissolved and the solution is ready for work ; the articles are cleaned in the ordinary acids. Care must be taken not to add too much ammonia or else the effect is spoiled, and a little more of the carbonate should be added to bring it back. The solution should be made in a crock or enamelled pan and used cold. Some very good results can be obtained if the articles to be blacked have got a small part or ornament in copper soldered on to the brass parts, for when the articles are prepared ready for bronzing and immersed in the solution, it will be found that the brass parts are black and the copper parts are a beautifully dark gold colour.

ELECTRO-PLATER.

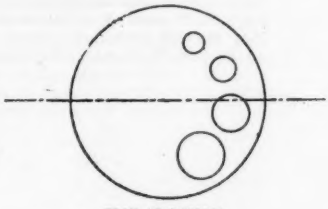
Screw-cutting Gauge.—Having to do a lot of screw-cutting of various pitches, it occurred to me that instead of having a lot of loose gauges which cannot be found when they are wanted, it would be much better to have one gauge which could be used for all sizes up to and including the size the gauge was made for. Referring to the accompanying sketches, Fig. 1 is a front view showing how the gauge is divided; Fig. 2 shews the view looking from the back; Fig. 3 is a plan, and Fig. 4 a side view. To use the apparatus, unscrew the milled nut *A* and slide pointer *B* up or down



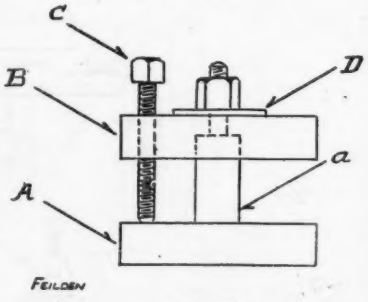
SCREW CUTTING GAUGE.



PLAN OF TOP.



PLAN OF BOTTOM.



ELEVATION.
DRILLING MACHINE JIG.

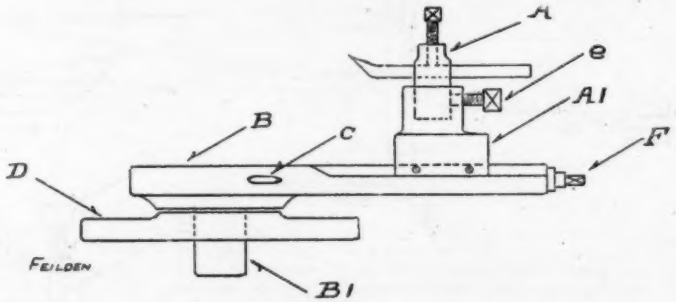
the slot until it reaches the diameter of the work it is required to screw-cut. Holding *B* firmly in position, move *A* along the top slot until the edge of plate coincides with the number of threads it is wished to cut. On tightening the milled nut *A*, the gauge is ready for work. The tool-rest *C*, on which the tool is placed to get the correct angle, is made to revolve on pivot *D*, so that it can be used for either an inside or outside tool, or as right hand and left hand tools, for which the tool-rest is made to swing to right or left. The milled nut *E* is for tightening the bottom slide which carries the tool-rest *C*, and is used for adjusting the height of tool-rest, so that it may be raised or lowered to suit the shank of tool which is used.

E. DANKS.

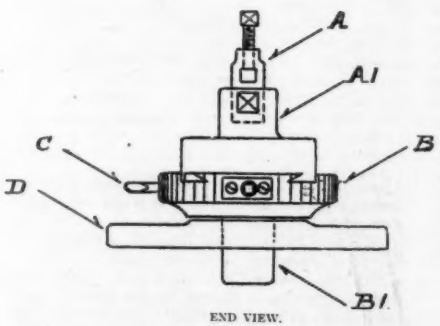
A Handy Drilling Machine Jig.—The Drill Jig here described is devised for enabling the user to drill a hole in the centre of a ball or round knob (such as the short pillars used to pass handrails through for Locomotive Engines, and also for fencing Stationary Engines off), or, in fact, anything concentric requiring a hole drilling straight in it, which is a rather difficult operation on an ordinary drilling machine table without any such appliance. *A* is a thick wrought-iron plate with the stalk, *a*, fast with it, and screwed at the top end for about 3 inches down, where it is reduced. *B* is also wrought-iron and about same thickness as *A*, and has from 4 to 8 holes drilled through according to size and diameter as shown, each one being a different size, with a screw-hole bored and tapped opposite as shown in the plan of top; these holes are not required in the bottom, but only the holes to be used for drilling through, and should be drilled when fastened to *B* to be sure of them being exactly in a straight line with each other. The jig should be fastened on the drilling machine table and the knob to be drilled placed between the top and bottom plates in the holes, same size as the holes required to be drilled with setscrew *c* opposite, care being taken to adjust this so as to keep top plate level. *D* is a washer covering stalk hole in top plate, which should be nipped down

tight on top of work ; start drill through top hole required and it will drill through dead centre of knob and run straight into hole below in bottom plate.

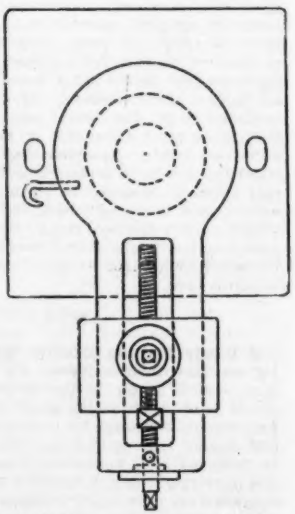
A Concentric Turning Rest.—Below is described a very cheap and useful concentric turning rest, applicable to any ordinary slide lathe, and used for turning governor balls, &c., or in fact anything requiring to be perfectly concentric, and also for rounding the ends of large connecting-rods off, as used for stationary engines. It does its work much more perfect than the old-fashioned method of working the screw-feeds by hand, as it is entirely automatic in its action, and therefore does not depend upon the operator any more than an ordinary slide rest, when once it gets fixed in position. The sketch below explains itself pretty clearly ; it will be seen that it is fixed between the headstocks in place of the ordinary slide rest, which is taken to the back end of the lathe bed behind the loose headstock. It will be seen from the accompanying sketches that the rest consists essentially of three iron castings, *A*1, *B*, and *D*, *D* is a square plate about 2 ins. thick, varying according to the size required, and made to bolt fast to the lathe bed, two slot holes shown in the plan, being provided for this ; a shallow boss is cast in the centre, faced and bored through to receive the stalk *B*1 cast solid with the slide *B*. *A*1 is a cast-iron cross slide, with a deep round boss cast on the top (slightly out of centre to get nearer the work to be operated upon, and therefore give more support to the tool, which should be firm) ; this boss is bored out to receive the wrought steel tool holder *A*, which can be raised or dropped as circumstances



ELEVATION.
CONCENTRIC TURNING REST.



END VIEW.
CONCENTRIC TURNING REST.



PLAN.
CONCENTRIC TURNING REST.

may require, and held firm by the square-headed set-screw marked *e*; the tool holder has a square hole cut through it, in which an ordinary turning tool is placed, and fastened down by the set-screw shown at the top. *F* is an ordinary square threaded screw for operating the cross slide which contains the tool holder. *C* is a small hook screwed into the long slide just beyond the centre; to this hook a small chain is attached and passed round the back of the loose headstock and on to the slide rest where it is fastened by a bolt in one of the T slots; the rest should then be brought round in a circle and the tool should point to the centre of the loose headstock and should start cutting there, as the slide rest travels away from the headstock, the chain drags the concentric rest in a circle towards the fast headstock, and therefore turns a perfectly round ball in its travel. This rest is very cheaply made and free from complications, and requires very little learning to operate, and can turn circles varying in diameter from 1 in. upwards, according to length of slide *B*; it has also an adjustable tool-holder, and therefore can be used on lathes of varying centres, and once introduced it not unfrequently replaces much more expensive appliances devised for the same purpose.

A Handy Drilling Machine Attachment.—This attachment was designed for facing and turning trunnion bosses on large castings which would otherwise have had to be done in the lathe. It afterwards proved extremely useful for facing and edging large facings. Referring to the two views sent herewith, Fig. 1 shows the arrangement attached to drilling machine spindle and operating on a trunnion boss which is shown in dotted lines. Fig. 2 shows an end view, with the star wheel on the end of the screw removed. The arrangement consists of a spindle (fitting the drilling machine spindle nose) to which is securely attached a horizontal arm carrying a tool slide. The slide is fed along the arm by a screw and star wheel, the tool being clamped in place by a swivel tool post. At the lower end of the vertical spindle a short peg is attached which should be made as short and stiff as the work will allow, the peg fitting into a hole drilled in the work and thereby steadying the cutting tool considerably.

F. WILSON.

Old Iron Piping for Trueing a Grindstone.—It has always seemed to me a real saving if a use can be found for anything that is worn out, and become quite useless for the purpose it was originally intended for. And although I have been in many workshops, large and small, I have never yet seen anyone use a piece of old iron piping, for turning, or trueing up a grindstone. And yet it is the very best thing for this purpose. Old gas or water-pipes, an old gun-barrel, or the tubes of an old bicycle, if not thinner than 12 guage, are excellent. It is best to heat the end of the tube red hot, and plunge it in cold water to harden it: and when using it should be slowly turned round in the hand, when it always presents a cutting edge to the stone. If a grindstone has not been used for a long time and become very hard, the face may be readily turned off by the above means, and again be made useful in half the time it would take to turn it up with a hardened steel bar, and there is nearly always a piece of old tubing to be found even in small workshops.

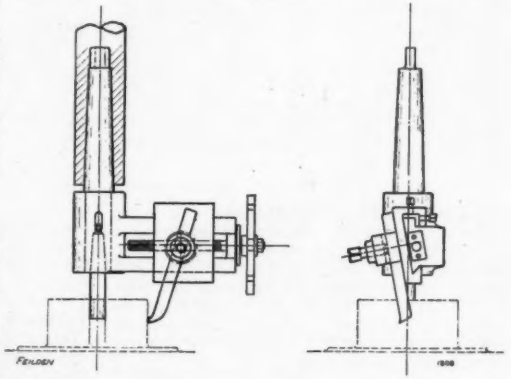


FIG. 1. FIG. 2.

DRILLING MACHINE ATTACHMENT.

H. B.

CONTRIBUTORS TO THE "WORKSHOP PRACTICE" SECTION

are requested to communicate with the Editor immediately on the publication of their articles, stating full title of contribution, name and address and nom-de-plume (if any).

THE ATTENTION OF EMPLOYERS OF LABOUR

in our great industrial-engineering establishments is specially directed to the announcement under the heading "Workshop Practice." Inventive capacity among workmen is much more encouraged by the masters in the United States than in Great Britain, and the result is apparent in the many new practical ideas which come quickly to the fore in that country. Those British manufacturers among our numerous subscribers and readers who will assist us in popularising this section will be rendering themselves a real service.

INDUSTRIAL PROGRESS

ENGINEERING NOTES AND COMMERCIAL INFORMATION

FROM ALL SOURCES.

CIVIL ENGINEERING.

Projects for the Construction of Bridges in Portugal.—The *Lisbon Gazette* contains an announcement that tenders will be received up to the 30th of this month (June), at the Ministry of Public Works, Lisbon, for the construction of bridges across the north and south branches of the river Mondego, on the high road between Galla and Figueira. The plans, soundings, &c., can be seen at the Ministry of Public Works, Lisbon. The *Gazette*, containing the notice with particulars and conditions, may be consulted at the Commercial Intelligence Branch of the Board of Trade, 50, Parliament Street, London, S.W.

Waterworks Projects in Madeira.—Consular reports from Madeira contain the information that tenders are invited by the Government of Madeira for the erection of waterworks, and also for the completion of a scheme of drainage for the city of Funchal. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office.

MECHANICAL ENGINEERING.

An Offer to Inventors.—The Association of the German Sugar Industry (*Verein der Deutschen Zucker-Industrie*), Kleiststrasse, 32, Berlin W., offers two prizes of 8,000 and 10,000 marks (£400 and £500) for a new and practical sugar-beet extractor or lifter—i.e., a machine for pulling up sugar-beets from the soil. A prospectus issued by the association and giving particulars can be obtained on application. The text describing the invention must be written in German, and be in the hands of the directors by August 15th. The sums named will be but a minor portion of the reward to the successful inventor, since there will be, no doubt, a great demand by sugar-beet growers in Germany and elsewhere for a mechanical device of so useful a nature, provided that the prize-winner obtains the manufacturing rights or even a royalty, which no doubt will be made known to applicants on inquiry.

Oil Engines for Palestine.—Another opening for our trade is to be found in the approaching demand for oil engines, which are coming into favour for the purpose of drawing water from deep wells and for irrigating the orange gardens. When these gardens are somewhat extensive and a constant supply of water is necessary for the irrigation of the trees, there have hitherto been employed from four to six or eight mules for turning the water-wheels, which involves an expenditure for their keep of from 6s. to 8s. each day. It is found that an oil engine of about 6 h.p. or even less will raise double the quantity of water in the same time that the horses or mules will, and that the expense of working an oil engine of the horse-power mentioned would be about equal to that of maintaining six or eight mules, the consumption of oil being about nine gallons per diem. In large plantations, therefore, it is manifestly more economical to use an oil engine than to adhere to the old methods. The attention of garden proprietors has been awakened to this truth, and there is therefore every prospect of machinery of this class finding ere long a market in Palestine. Several of these engines have already been imported from Germany, and our own manufacturers might profitably enter into this field of competition, where they cannot but be successful if they endeavour to meet, as their rivals are always ready to do, the requirements of the plantation owners.

Saw-Mill Machinery for the Gold Coast.—It is stated on good authority that the mahogany industry of the Gold Coast is assuming immense proportions, and that in the adjacent French territory (the Ivory Coast) this industry is also being carried on on a large scale. A number of new saw-mills were erected in 1899, and some additional new mills will be built in the near future. Our manufacturers might profit by these conditions.

Well-Drilling Machinery and Pumps Required.—The United States Consul at Beirut, Syria, has been making efforts to introduce American well-drilling and pumping machinery

into Syria, where the semi-arid lands can be rendered cultivable by irrigation. It is stated that he has succeeded in arousing considerable interest in the subject, and he reports that MM. H. Sallag & Fils suggest that an expert be sent from the United States to Syria to canvass the field and assist in opening a market. The firm mentioned is ready to pay part of the expenses, expecting to be appointed general agents for the manufacturers. The United States Consular Agent at Tripoli writes :—"In northern Syria, there are thousands of acres of as good land as there is in the world suffering for lack of water, and all that is needed is some one to make the start. One good artesian well would set this country wild on the question of irrigation by the use of modern machinery. It would pay some of our American well-drilling machinery makers to come here and show what they can do in this line." United States Consular Agent Schumacher, a civil engineer, writes to an American contemporary from Haifa :—"I laid the contents of your letters before our leading merchants and landowners, and found a willing ear everywhere and decided interest in the introduction of windmills and drilling machines ; but none of them wishes to risk the first order, and all unanimously expressed a desire to see one of the mills working, promising to order several if they turned out satisfactorily. As I have no doubt that the American wind engines will answer the purpose, I strongly recommend the sending of a sample mill to Haifa, which I would erect at Kefr Etta, one of Sursock's farms (Mr. Sursock is a Beirut capitalist) ; and I think I could guarantee orders for half a dozen, provided the sample works easily and supplies sufficient water for irrigation purposes." The Germans also are active in pushing the sale of this class of goods in arid countries, for it is stated by a correspondent from Yafa that the German colony has introduced pumps driven by petroleum engines, which seem to meet with favour, as many orders have recently been given for this kind of machine.

Siberia as a Field for Exports.—The steadily growing development of Siberia opens a field for the export of machinery that will certainly not be overlooked by our competitors. According to reliable information the demand for mining machinery promises to keep on increasing, as new syndicates and companies are almost constantly being organised. One of the most recent organisations is a joint-stock company that has been formed in Irkutsk, on Lake Baikal, with a capital of 1,000,000 roubles, to develop the ironfields lying in the neighbourhood of that city. Another company was also organised not long ago in St. Petersburg, with a capital of 6,000,000 roubles, to work the iron mines in Western Siberia. Adding to this, that many of the large gold-mining companies in the Altai mining district are about to increase the capacity of their works, it is evident, as the *Manufacturer* points out, that there will be a heavy demand for all kinds of mining machinery and appliances in the near future.

The Behrend-Zimmermann Process.—A considerable amount of excitement has been aroused all over Germany by the surprising efficiency of the Behrend-Zimmermann process, demonstrated in the Royal Technical High School of Charlottenburg, near Berlin, during a series of experiments made by Professor E. Josse. In order to appreciate the value of the result of these experiments it will be well to remember that the ordinary high-pressure steam-engine, after passing steam through one cylinder, discharges it into the air, utilising hardly more than 5 per cent. of the value of the fuel consumed under the boiler. The compound engine, in which the steam, after passing successfully through two or more cylinders, is condensed, and the warm water of condensation is restored to the boiler, is somewhat more effective. But even at its best it utilises hardly more than 12 to 13 per cent. of the fuel energy. An enormous advance, therefore, in the economical utilisation of the fuel and latent power has been obtained, as the above-mentioned experiments made by Professor Josse show, by means of the device which is the joint invention of Mr. G. Behrend, a Hamburg engineer, and of Dr. Zimmermann in Ludwigshafen. The machine used was an ordinary compound engine with a stroke of 500 millimetres (19·69in.) and a speed of 41·5 revolutions per minute. By the device of the two inventors, the exhaust steam is made to pass from the low-pressure cylinder into a surface-condenser, named the "vaporiser." In this vaporiser the cooling medium used, instead of water, is liquid sulphurous acid, which has an extremely low boiling point, and, therefore, is immediately decomposed by the heat of the exhaust steam, thus liberating the sulphur dioxide gas, which passes over into the cylinder of an auxiliary engine, when it performs the work, as does the steam in an ordinary steam-engine. The auxiliary cylinder in Professor Josse's experimental machine had a diameter of 300 millimetres (11·81in.) and a stroke of 500 millimetres, with a speed of 77 revolutions per minute. After passing through this auxiliary cylinder, the sulphurous vapour enters the surface-condenser, the tubes of which, just as in an ordinary engine, are cooled by a flow of cold water around them, and having been there condensed into a liquid, is forced back into the "vaporiser," where it begins the cycle again, the same sulphur dioxide being used over and over again. There are, therefore, in the Behrend-Zimmermann process two condensers, the first representing, so to say, a boiler, or steam generator, for the auxiliary engine ; and this boiler, instead of being

heated by coal, obtains all its heat from the exhaust of a primary steam-engine, and instead of converting water into steam, evaporates an immensely more volatile liquid. In the series of experiments published by Prof. Josse the following results were obtained. The steam-engine, a machine of good modern construction, being given a steady load, developed 34 indicated h.p. with a consumption of 8·6 kilogrammes (18·96 lbs) of steam per indicated h.p. The auxiliary machine working with the sulphurous vapour indicated 1·9 h.p.—i.e., an increase of 76 per cent.—thus yielding, instead of 1 h.p., 1·56 h.p. for the same amount of steam consumed, and reducing the steam consumption from 8·6 kilogrammes to 5·5 kilogrammes (from 18·95 to 12·13 lbs.) per indicated h.p. The average result, in fact, was a gain of 1 h.p. in the auxiliary machine for every 15 kilogrammes (33·169 lbs.) of steam passing through the main engine. The expense of this improved device is represented almost entirely in the cost of construction of the vaporiser, condenser, and auxiliary engine, while the increase of efficiency is such that from a 2,000 h.p. engine sufficient power may be obtained for another 1,000 h.p. engine, which means 50 per cent. additional power added without a pound of extra fuel. Under these circumstances the general notice that this device is receiving in Germany is quite natural.

Air as a Lubricant.—Oil and other fatty lubricants present considerable drawbacks when used as lubricants for mechanical apparatus of a special nature; it is therefore not unlikely that the idea of using ordinary air as a lubricant, for which Prof. Albert Kingsbury has designed a machine, may find its practical application. The machine consists of a steel piston or short shaft to be rotated, and a cast-iron ring or cylinder which acts as a bearing for the shaft, the whole being supported on rollers mounted on a suitable frame. The shaft weighs 50½ lbs., is 6½ in. long and 6in. in diameter, and its weight constitutes the total downward pressure on the bearing. The diameter of the cylinder is slightly less than $\frac{1}{1000}$ in. larger than the shaft—a fairly loose fit. Both cylinder and shaft are ground exactly parallel. The cylinder is set horizontally, the shaft inserted (both being perfectly clean and dry), and rotated with the hand by the handle at the end. It can be turned with difficulty at first, and the harsh, grating sound of metal rubbing on metal will be heard. With an increase of speed, however, this grating ceases and the force required to turn the shaft is materially decreased until, after a few revolutions, the shaft becomes entirely free from the cylinder and rotates on the film of air between. Set rotating at, say, 500 revolutions per minute, it will continue to rotate four or five minutes. If allowed to run, the speed gradually decreases from the start until suddenly the piston breaks through the intervening layer of air, and a few more revolutions suffice to bring it to a sudden stop. If a more conclusive proof is required that the shaft is entirely separated from the cylinder, an electric bell may be included in a circuit of which the shaft is made one terminal and the cylinder the other, when it will be found that the bell is silent as long as the shaft rotates at any considerable speed.

ELECTRICAL ENGINEERING.

The "Telegraphone."—A very interesting device has been recently patented by a Danish inventor, Mr. Vandemar Paulsen, who has combined the phonograph and the telephone so as to constitute an apparatus of practical utility. In place of Mr. Edison's wax-cylinder for receiving and reproducing sound, Mr. Paulsen uses a steel band or wire. This steel band passes between the poles of a small electro-magnet, the coil of which is connected with a telephone. When speaking into the telephone the pulsations of the current produce a variation in the strength of the electro-magnet, which in turn affects the magnetism of the steel band. This band, therefore, is variably magnetised at different portions of the length, corresponding to the variations of the current produced when speaking, and it remains in this condition for a considerable time. When this steel band is passed again between the poles of this electro-magnet or of another similar one, it reproduces the variations of the current in the magnetising coil and they are transmitted to the telephone, when they are reproduced in the form of sound. In this way the steel band can be used many times. If it is desired to restore the steel band to its original condition and to remove the traces of the last message, it will suffice to pass the band between the poles of a strong electro-magnet, or to send an electric current through it, when all its magnetism will disappear. At first it was thought that the practical use of the device would be limited, owing to the fact that for registering a message of any great length, a very long band might be needed. This drawback, however, was removed by Mr. Paulsen's assistant, Mr. Petersen, who combined the apparatus with another device, rendering it possible to record several messages on the same steel band without interfering with each other. The practical use of the device, called by the inventor "telegraphone," lies in its employment in connection with telephone systems, since it will make it possible to register telephonic messages during the owner's absence, which he can receive on his return, by making the phonographic steel band reproduce the message.

British Supporters of American Competition.—The United States Consul at Nottingham, Mr. T. C. McFarland, informs his compatriots

that the municipality of that city proposes to build electric street railways to supersede the horse tramways, and adds:—"Committees from the council were appointed to investigate electric service elsewhere, and last year the United States was visited for that purpose by local engineers. The overhead idea was finally adopted. By December 25th, 1900, one branch of the proposed system will be in operation, the others to follow quickly. No statement is obtainable as to when the whole system will be complete. The city owns extensive gas and electric light works, and it is assured that no expense will eventually be spared in creating a modern street railway system, with a central depôt and adequate suburban service. Contracts for experimental motors have been placed in Sheffield. If not satisfactory upon trial, other offers will be considered. The bodies of the cars will be built in England, but a Philadelphia firm is under contract to make and deliver the wheels. The wire contracts are likely to go to New Jersey. American steel rails are also under consideration. American bids for miscellaneous material will receive attention, and inquiries should be addressed to Mr. Arthur Browne, city engineer."

The Johnson-Lundell System.—The opponents of the trolley-wire tramways ought to welcome the appearance in the field of competition, of a system that is based on the surface-contact principle, and free from the drawbacks of both overhead wires and the conduits methods of distributing current. Its supporters make the most sanguine predictions regarding the results that will be obtained by it. It is not so much, it is said, that the inventors have made any far-reaching new discovery, as that they have succeeded in making improvements in dynamos, motors, controlling switches, methods of motor-control, &c., and in combining them in such a way as to constitute an ideal system of electrical traction. The promoters claim that their new generators can be built with 20 per cent. less material and 15 per cent. less cost than corresponding machines of the hitherto known types. It may be mentioned that the inventors claim to have succeeded in reducing the loss of energy to a minimum, and when a car is running downhill its motor becomes a brake and sends the current back into the line; thus the power of gravity of a descending wagon is utilised for pulling uphill one that is ascending.

Thermo-Electric Generation.—One of the most interesting problems occupying the attention of engineers and theoretical scientists is the question in what way electricity could be developed directly from coal, and whoever should succeed in solving it on a commercial basis, may be certain of fame as well as of material reward. There have been made in recent years some more or less successful attempts to generate electricity from a carbon cell, but none of these has led to the construction of a practical device. Prof. C. Liebenow, in discussing this subject recently before the Electrical Engineering Society of Berlin, expressed a doubt if the energy derived from such cells may, after all, not be due to the difference of temperature at the contacts. Commenting on the theoretical efficiency of thermo-electric couples, Prof. Liebenow deduces from the laws of Claudius and Carnot that if a difference of 980 deg. C. could be maintained between the two junctions of such a couple, an efficiency of about 77 per cent. would be possible. This, however, refers only to short-circuit and he concludes that with the most economical method hardly more than 28 or 29 per cent. of energy could be obtained. In practice, however, even this percentage could not be approached. Nevertheless, assuming that even as much as 15 per cent. of energy could be developed it would still be far more economical than our present system, in which coal produces heat to generate steam, which furnishes the mechanical power to drive an engine, that, in its turn, serves to rotate a dynamo from which finally the current is obtained. The inventor, therefore, of a practical device by which as much as 15 per cent. of electrical energy could be derived direct from coal would confer a boon upon the world.

Dry Secondary Cells.—In a recent issue of the *Centralblatt für Accumulatoren und Elementhunde* (Central Journal for Accumulators and Batteries), Professor Liebenow, discussing the subject of dry secondary cells, arrives at the conclusion that efforts to produce a practical cell of this description are foredoomed to failure. He supports this view by demonstrating that in a secondary cell, during its working, electrical concentration currents are set up which tend to convey the acid in the pores of the plates from points of maximum to points of minimum concentration. These currents are necessary to equalise the strength of the acid and produce this effect far more rapidly than would be the case if diffusion were acting alone. When, however, a gelatinous electrolyte, or a dry non-conducting powder is introduced between the plates, this equalisation is prevented, and the cell is soon exhausted.

Electric Traction on French Railways.—The French are in earnest, it seems, in their efforts of introducing electric energy into the service of railways in place of steam; at all events the authorities are taking preliminary steps for determining the probable effect of such a change, and the conditions under which most surely success could be expected. As we learn from our contemporary *L'Industrie*

Electrique, a commission has been appointed in consequence of an order of the French Minister of Public Works, for the purpose of investigating the various questions connected with an eventual application of electric traction to the great network of railways existing in the French Republic. The president of the Commission is the famous scientist M. Berthelot, and amongst its 24 members are to be found nearly all the great railway engineers of France. The work of the commission has been divided between three sub-commissions. The first of these, which is charged with investigating the trials so far made to introduce electric traction, will have to answer the questions: What attempts have been made in this regard on the French railways? Are these trials sufficient to form a competent opinion? Are they similar to those made in other countries? In how far do these attempts encourage the application of electricity in other countries? The second sub-section has for its task to decide how the agreements and rules governing railways would have to be modified in case electric traction was adopted. The questions which this second committee will have to answer is whether the agreements that bind the railway companies are of a nature to promote and encourage the development of electric traction, and if not, what modifications or additions ought to be introduced in the system of charging and in the working rules. The third sub-commission is to investigate the utilisation of hydraulic power as a motive force and to state whether there is any reason for modifying or adding to the legislation affecting the management of water-courses, from the point of view of the railway companies. It would also have to ascertain what provisional measures should be taken, pending the drawing up of new laws, to reserve for the railways the necessary water-power available in different districts.

Niagara Falls Power Transmission on the Canadian Side.—On the 12th of April, this year, an agreement was signed by the Canadian authorities between the Ontario Power Company of Niagara Falls and the Commissioners of the Queen Victoria Niagara Falls Park. This ends a long and bitter opposition by the United States company to the rights asked for by the Ontario company, and the approval of the agreement by the Ontario government completes the franchise for the development of 300,000 horse-power, or more, on the Canadian side of the Falls, since the charter of the Ontario company was granted by the Dominion Government many years ago. The estimated cost for developing the 300,000 electrical horse-power is $10,000,000, and it is intended to bring water from a point where the Welland River empties into the Niagara, by a canal to the bluff below the Dufferin Islands, where under a head of 45 feet the first development of 60,000 horse-power will be made. From this place the water is later to be carried by an open canal through the park to a point just below Table Rock, where under a head of 160 feet the remaining 240,000 horse-power will be developed. The work will be begun immediately. The cost for the development of the first 60,000 horse-power will be $2,000,000, and negotiations are in progress with many prospective customers, notably a number of electrolytic concerns and an immense steel plant. The local demand for power is considerable, but there are, besides, good prospects for transmitting power to Toronto and Hamilton, in Ontario, and to Buffalo in the United States. The highly satisfactory results obtained by the United States company augurs well for the future of the Canadian enterprise, which is in the hands of men of considerable distinction, wealth and influence.

A Large Centrifugal Pump.—A very large centrifugal pump, driven direct by means of two-phase asynchronous motors of 1,000 h.p., has been installed to supplement the existing piston pumps in the waterworks at Coulouvrenier, near Geneva, Switzerland. According to the *Schweizerischi Bauzeitung*, this pump is remarkable not only as regards its size, but also as regards the great height, 460 ft., to which the water has to be lifted. The pressure for this purpose is furnished by a tandem arrangement of two centrifugal vanes, and injectors are employed to fill the pumps, which are started with closed valves, so that in the beginning the motor has to overcome only the friction of the water. Only after the normal speed of 600 revolutions per minute has been obtained, the valve is slowly opened and the lifting begins, so that the load on the motor is gradually increased. The out-put of the pump is 5,000 gallons per minute, which is equivalent to a useful output of 700 h.p. The current required for driving is supplied by the power station in Chèvres. The pump was constructed by the firm of Sulzer, Bros., of Winterthur.

Electrical Signalling Arrangements, Great Central Railway.—Subsequent to compiling the last instalment of the article on the Great Central Railway, we learn that the whole of the work of producing the electrical apparatus used in block working of the line, &c., was carried out by the Electrical Department of the Great Central Railway and that no watertight bells in signal cabins or watertight treadles have been used in connection therewith.

The voltages of the various dynamos supplied by Messrs. Royce, Ltd., Siemens Bros., Ltd., and the Brush Electrical Co., is 210 volts.

IRON AND STEEL.

Blast Furnace Gases.—There is hardly an innovation in the iron industries of such far

reaching results to be recorded at present as the direct use for motive power of the bulk of the gas given out by the blast furnaces. These furnaces are the most convenient gas producers imaginable, which, purified rationally and adapted in a suitable manner for the various purposes for which they may be used, constitute a very excellent source of heat production. Germany is first in the field in the use of this abundant supply, for in that country there are 41 engines in work, with an aggregate of 21,950 horse-power. The little principality of Luxemburg comes next with 12 engines and a total horse power of 6,760, while Belgium has 8 engines of 3,700 horse-power, France 8 of 3,250 horse-power, while Great Britain at present is far behind, there being only 6 engines working with blast furnace gas, representing a total of 2,060 horse-power.

Various forms of motors have been devised for the use of these gases, the most suitable of which, according to M. Emile Demenge, the author of an article in the *Revue Générale des Sciences* on the subject, seem to be the "Simplex" of M. Delamare-Debouteville, the Otto motor and the motor of the Oechelbauser. The saving resulting from the uses of furnace gases is so obvious that it is sure to bring about a complete revolution of practice. Heretofore the heat necessarily generated in the furnaces for producing the pig-iron was employed for hardly anything except the blowing of the furnace and the heating ot the blast, the taking up the water and the charges, and, where required, the breaking and the roasting of the ore; but henceforth the surplus will be utilised in many new ways, such as the charging the furnace by trolley-wagons, as at the Maryland Iron and Steel Works, and the suppression of hard labour in rolling mills situated in the neighbourhood, or for other quite independent purposes, such as electric lighting in towns near by, the production of calcium carbide, electrolytic processes of various natures, &c. Those manufacturers who do not introduce this new source of power as soon as possible in their works may see themselves left behind in the eager competition of our times when it is too late to regain the lost ground.

The Influence of Copper in Steel.—Our German contemporary *Stahl und Eisen* publishes a contribution by Mr. A. L. Colby, giving the result of experiments made for the purpose of determining the influence of small quantities of copper on the mechanical properties of steel. These results show that neither a propeller shaft with 0·565 per cent. of Cu, nor a gun tube with 0·553 per cent. of Cu, showed any defects after forging and hardening; armour plates with 0·575 per cent. of Cu, welded and flanged well, and answered all the requirements of the American navy. Bessemer steel with 0·11—0·65 per cent. of C., and 0·292—0·486 per cent. of Cu showed no red shortness on rolling, nor did Bessemer steel for rails, Martin steel 0·075 per cent. of Cu for fire boxes, or nickel steel with 0·08 per cent. of Cu for bicycles.

The American Iron and Steel Industries.—Although in the beginning the Commercial Exposition in Philadelphia was looked upon with suspicion and treated by German manufacturers as of no benefit whatever except to Americans, the correspondence of those German experts who visited it appear to have changed the whole course of public opinion, and it is now admitted that both the Exhibition and the Commercial Museum at Philadelphia were of the greatest educational value to those who visited them, no matter of what nationality those visitors were. What they saw seems to have made a profound impression upon all the German experts, and it may not be without interest to our readers to learn from a few quotations of an interview with the director of one of the largest steam plants in Germany, published in the *Berliner Tageblatt*, what a competent German iron-master thinks of the condition of the American iron and steel industries and their future prospects. "It is undeniable," he said in reply to a question, "that the American ironworks operate under decidedly more favourable conditions of production than our own. An important factor in these conditions is the fact that the United States possess far richer and more widely distributed iron ore deposits than Germany. While we are largely dependent upon imported ores, especially Swedish, the American ironworks find their raw material at home. To this must be added the other important advantage, that the construction and equipment of their iron and steel works far excel those of Germany and, indeed, every other European country. In America, we find what seems to us an astonishing substitution of machinery for manual labour. Only in the most necessary details is hand-labour now employed. Such a vast and skilful application of machinery offers especial advantage at a time like this, when manual labour is costly and difficult to obtain. Finally comes the enormous advantage which the Americans enjoy through the high development of their railway system. The rates of freight are excessively low: while on the German railways the cost of freight per ton kilometre is—excepting some unimportant special tariff—2·2 pfennigs; in America the rate is only 0·6 pfennigs per ton kilometre. Under these conditions the German iron industry finds in that of the United States its greatest, most important, and most dangerous competitor . . . Several shipments of American foundry pig-iron to Germany prove that we have in future to reckon with the competition of American metal here at home."

To the question, how can the German market protect itself against the future com-

petition of America? the following answer was given:—"The German iron and steel works must follow the American example, and by a greatly enlarged use of machinery reduce the cost of production . . . There is also urgently required for our industry much lower freight rates and the construction of special lines and extra tracks (as in America) for freight traffic." This reply indeed is the only rational answer to the problem. Might not our British iron-masters take a hint from this and endeavour to bring about a corresponding change in the equipment of their own works and in the means of transport provided for their raw material and manufactured products.

Steel and Iron Industry in Germany.—The following statistics regarding the condition of the iron and steel industries in Germany during the year 1898 have just been published and show considerable progress. "The output of iron ores has advanced from 11,457,000 tons in 1893, to 15,900,000 in 1898, the average value per ton having for the same period increased from 3s. 6d. to about 3s. 9d. The number of mines at work has, however, diminished from 561 in 1893, to 550 in 1898. That there has been a material increase in efficiency of the individual worker, as well as in the output of the individual mine, is proved by the fact that the number of workers between 1893 and 1898 had only increased from 34,845 to 38,320. In addition to the ores produced at home in 1898, Germany made use of 2,718,000 tons of imported ores, her total consumption in that year having been 18,183,000 tons, or an average, including imported ores, of about 2¼ tons of ore per ton of pig. The German production of pig-iron in 1898 was 7,313,766 tons, against 6,881,466 tons in the previous year, and 4,986,000 tons in 1893. The number of workmen employed at German blast furnaces had increased from 24,201 in 1893, to 30,778 in 1898, but the average output of pig-iron per workman had increased from 206 tons to 240 tons. Within the same interval the average output of pig-iron per furnace in blast increased from 24,400 to 28,700 tons. As regards manufactured iron, there were still, in 1898, 176 works in Germany engaged in the production, of which the total output was 1,077,363 tons, against 1,031,691 tons in 1897, and 1,078,065 tons in 1893. The number of workmen engaged in malleable iron works in 1898 was 38,135, which compares well with 39,958 in the previous year and with 40,342 in 1893. The German output of finished steel has increased from 2,231,873 tons in 1893, to 4,352,831 tons in 1898, while at the same time, the output of ingots, billets, &c., for sale, has increased from 931,569 tons to 1,428,173 tons. Hence, in 1898, there was an increase of 2,618,000 tons, or 82 per cent., in the total German steel production, which is by far the largest advance made in any similar period. The number of works in the German steel industry has, during the same six years, increased from 139 to 170, and the number of workmen employed in them from 65,944 to 70,650.

MINING.

A New Eldorado.—Not only mining experts but men in general are turning their eyes full of expectation toward the gold-bearing beach-sands of Cape Nome and a rush may be anticipated during the present summer that will recall the great exodus to Klondike. The general northward movement is already very noticeable in the Western portion of the United States, and the number of deserters from Klondike hastening to the new land of promise is steadily increasing. How many of them will find misery and starvation, instead of gold and wealth, in these distant regions, is a thought not pleasant to dwell on. Very little reliable information is obtainable so far regarding the prospects of miners, the methods most suitable for working the new placer mines, and the requirements most necessary. So much, however, is certain, that only a very small percentage of those who hasten to Cape Nome will see their hopes fulfilled. Klondike, one should think, would be a lesson to fortune-seekers, but the mere chance of becoming rich within a few weeks is so strong a temptation to those that know no other curse than that of poverty, that no warning will have any effect. In order to prevent lawlessness, or to minimize its occurrence, Congress has passed a bill to regulate beach mining at Cape Nome, and the representatives of Alaskan interests seem to be satisfied with its provisions. The Act of 1898 reserves along the coast and the shores of all waters in Alaska, a highway of 60 feet in width, and the riparian rights, as the property of the government. Last year the richest deposits of gold were found upon this reservation and the beach between it and the sea at low water, which is called "tide land." By a strict interpretation of the law, of course, this locality is forbidden ground, but it would be totally impossible to enforce the law. The government and Congress, recognising this, have decided to legalise what the miners at Cape Nome have already done and to give the force of statutes to the regulations they have adopted for their own government. The Bill, therefore, allows individual miners to locate claims upon the sea-beach, twenty-five feet in width, and miners' meetings may, on their discretion, enlarge them to a maximum limit of 300 feet in width. This, it is believed, will go a good way in preventing serious disputes regarding ownership.

Gold Mining in China.—Russian enterprise has developed a splendid mining field in China, in the Sungari region of Eastern Manchuria.

About a year ago an expert gold-miner, M. Mosskvin, of Senispalatinsk, visited the district, discovered its possibilities, and concluded an agreement with the local Chinese authorities for its development. He then engaged Russian workmen at Drenburg and in the Altai mountains, and came back with them and a plant of modern mining machinery previously unknown in that part of China, and worked the deposits with great success. In the valley of the river Shagun, millions of poods (1 pood= 36 lbs.) of auriferous earth lie on the surface of the soil. It had evidently been worked many years previously and abandoned because the primitive way of working the auriferous earth entirely by hand, the only way known to the natives of the district, did not yield sufficient profit. At present, two Russian colonies are at full work in the Sungari mountains, which not only are rich in gold sand, but contain also immense deposits of naphtha and coal. There exists, therefore, a profitable field for enterprise, and there is little doubt that in the near future other Russian capitalists will invade these gold-bearing regions of China.

Our Coal Export Trade.—A Parliamentary return, "giving for the year 1899 the export of coal from each port in the United Kingdom to each country abroad," &c., has been issued in compliance with the request of certain members of the House who were alarmed at the possibility of Great Britain's coal resources becoming exhausted. The statistics published in this report show that our total exports last year have been, in round figures, 41,118,000 tons against 35,058,000 in 1898, which shows an increase of nearly 6,122,000 tons. The overwhelming proportion of this export went to the countries of Europe and North Africa, which, in the aggregate, received 36,000,000 tons. Of this aggregate, 16,394,000 tons went to Northern Europe, *i.e.*, to North Russia, Norway, Sweden, Denmark, Germany, &c. The remaining 19,537,000 tons were imported into Southern Europe, embracing France, Portugal, Italy, Turkey, South Russia, and to Egypt, &c. These statistics speak for themselves and are a splendid testimony to Great Britain's wealth. Taking them, together with the recently published almost unanimous opinion of experts, that there is no danger of the coal supply becoming exhausted for many centuries, they are such as any country might be proud of.

RAILWAY WORK AND TRACTION.

Railway Material for Brazil.—A line of railroad connecting San Paolo and Bahia, Brazil, is now under consideration. It will probably start from the Conguista station on the Mogyana railway and pass through Arana, Sacramento, Bagayem and across the Serra di Pileo to the Paracuta. The terminal point will be the Port of Buritz on the Paracuta, an affluent of the San Francisco River. The total length of the line will be 311 miles, for which the company will ask a grant from the States profiting by the new line. Dr. Caetana Cesar de Campos is the Director-General of ways and works, and will, it is stated, be in charge of this work. His address is : 3, Rua Maria José, Rio de Janeiro, Brazil.

Excellence of British Locomotives.—The British Consul at Stockholm, Mr. Macgregor, says it is pleasant to obtain such striking evidence of the excellence of British work as is furnished by a report on the Swedish railways. It appears that locomotives built in Manchester in 1873, "thanks to the uncommonly fine workmanship," are still in sufficiently good condition for short trains, and as supplementary locomotives are even employed for the fastest trains now in use. Of the British engines still in daily service, three were manufactured as long ago as 1856, three date from the year 1858 and two were constructed in 1859, while there are quite a number that are from thirty-five to forty-four years old.

Foreign Products Imported for Study.—The Bavarian State railway administration has, as the *Fränkischer Courier*, published at Nuremberg, states, addressed a letter to the well-known locomotive manufacturers Maffei and Krauss, at Munich—from whom it has received heretofore its entire supply of locomotives and who naturally have expressed their surprise at an order given for locomotives from America—in which it is explained that these engines are imported from Philadelphia for the sole purpose of studying the many details wherein they differ from German locomotives, so that, as far as this seems advantageous, these may be adopted in the future construction of locomotives for the Bavarian State Railways. The newly-imported engines show, as the administration adds, in many respects noteworthy variations from the construction customary in Germany, especially in respect to the boilers, cylinders and frame construction, dimensions of the axles, valves and valve-gearing, the couplings and buffers. On the other hand, however, many portions are not as carefully constructed as is the case in German locomotives. The general direction concludes by saying that its object is to give Bavarian locomotive-builders full opportunity to familiarize themselves with the construction of American machines and invites the manufacturers to have them carefully studied by their engineers. It will be granted by all true business-men that the German officials are adopting a far wiser attitude toward foreign competitors than those who treat superciliously all foreign achievements and think it to be below their dignity to learn from others.

Locomotives for Russia.—According to the London correspondent of the *Birmingham Daily Post* advices have reached an official quarter from St. Petersburg that tenders for the supply of 200 locomotives and some thousands of goods trucks will shortly be invited by the Russian Government. The locomotives are to be of unusually heavy make and great power, capable of drawing a load half as heavy again as that allowed for the engines already being employed on the completed sections of the Trans-Siberian Railroad.

TEXTILE INDUSTRIES.

British Textile Manufactures.—The British textile trade with Thessaly has shared, together with that of other countries, in the general improvement of commerce in that country; but, as the British consul at Volo says in his report for the past year, the volume of our trade there is not so great as it ought to be. Germany takes the lead in imports, followed by Austria, Great Britain coming next; and as there is direct steam communication between England and Volo the proximity of Germany and Austria to Thessaly does not entirely account for their predominance. As the requirements of the population are increasing year by year, while Volo is becoming one of the most important commercial centres in the kingdom, the Consul discusses at some length the reasons for the present position of British trade there. He thinks it due in a great measure to the complete absence of British merchants, while there are many foreign commission agents who make their profits out of British trade, but naturally place orders in their own countries whenever they can do so. The consul adds, that after twenty years of observation he has come to the conviction that British goods, as a rule, can hold their own in the Levant both for price and for quality with those now supplanting them, but the absence of British traders and agents leaves the field free to foreigners. Taking this into consideration it speaks well for the quality of our manufactures that they are still so much in demand. "The remedy," he says, "exists and is in the hands of our merchants at home. Let them, even thus late in the day, turn their attention towards the encouragement of the few British traders who still carry on business in the localities referred to, let them accord all possible support to Englishmen establishing themselves abroad, and the benefit to our trade would be appreciable."

Woollen Goods for Palestine.—With regard to British trade in Palestine, Consul Dickson reports that the amount of our trade last year was good in value, having reached the amount of £100,465, or about 14·2 per cent. of the whole value of the imports and exports. Compared with other countries England stands next to France, which took up about 18·4 per cent. in 1899, and it is far ahead of Germany, whose proportionate share was 7·1 per cent. It must, however, be pointed out that Germany is making far more rapid strides in increasing her trade than our own country, for while Germany's exports have increased 54·8 per cent., and her imports 31·2 per cent. as compared with the trade of 1898, Great Britain's exports and imports have increased only 6·8 and 11·8 per cent. respectively. England absorbs nearly the whole trade of oranges, and holds still her own as regards cotton goods, but yet there seems to be a great scope for British home producers to place their woollen goods on the market, since the imports from other countries compare very unfavourably in wear and tear as well as in warmth with the British article, so that, as the consul remarks, manufacturers in England would do well to give their attention to the matter.

A New Source of Silk.—An extremely interesting paragraph appears in a recent number of our contemporary, the Philadelphia *Manufacturer*, referring to an insect that may become a rival to the silk-worm. We quote from it, verbatim, the following: "One of the most novel exhibits in the colonial section of the Paris Exposition will be a complete set of bed hangings manufactured in Madagascar from the silk obtained from the halabe, an enormous spider that is found in great numbers in certain districts of the island. It was a missionary, Father Camboue, who was the first to conceive the idea that these insects might be made to replace the silkworm. He succeeded without difficulty in obtaining a sufficient quantity of silk to be of practical use, but he did not pursue his efforts beyond the purely experimental stage. The matter has since been taken up by M. Nogue, the head of the Antananarivo Technical School. The results he has already achieved show that the production of spider silk should quickly become a highly important industry. The chief problem to be solved was to find a practical process for extracting silk from the female spiders. M. Nogue has invented a most ingenious appliance for this purpose. It should be said that the female halabe allows herself to be relieved of her silken store with exemplary docility, and this in spite of the fact that she is distinguished for her ferocity; her usual treatment of the males who pay her court is to eat them, and she feasts without compunction on members of her own sex weaker than herself. M. Nogue's apparatus consists of a sort of stocks, arranged to pin down on their backs a dozen spiders. The spiders accept this imprisonment with resignation, and lie perfectly quiet while the silken thread issuing from their bodies is rapidly wound off on to a reel by means of a cleverly devised machine worked by hand. Each of

the twelve spiders thus "milked" simultaneously yields from three to four hundred yards of silk. The spiders whose threads have been exhausted are set free, and ten days afterwards they are again ready to undergo the operation. The silk of these spiders, which is of the most extraordinary brilliant golden colour, is much finer than that of the silkworm, but its power of resistance is remarkable, and it can be woven without the least difficulty."

MISCELLANEOUS.

The Factories and Workshops Amendment Bill.—The favourable prospects for the passing of this Bill have been gradually but steadily fading. It appears that 100 amendments have been put down which threaten to smother it. The fact is that its supporters were somewhat hasty in their approval and committed themselves before knowing its contents. The powers given by it to the Home Office to make rules and regulations go much further than appeared to be the case before the text was published, and may prove dangerous without some check. There is also a strong objection in the eyes of many to the two-shift system which appears to be a retrogressive step as regards the hours of labour. These, however, are not the only provisions that are strongly opposed, and, in fact, it is very doubtful whether the Bill can be so amended as to secure a majority and to satisfy the Government responsible for it.

New Water-Gas Process.—Water-gas, which has great advantages over other kinds of gas owing to its great combustibility, is unfortunately a somewhat expensive article. Should, however, a method devised by Mr. Carl Dellwick, turn out to be successful in practice, its cost would be reduced by half and its use would increase correspondingly. This method consists (1) of a period of blowing hot air under the grate of the gas-producer for ten minutes, in order to raise the charge of coke to a high temperature; and (2) of a period of introducing steam into the gas-producer during the time necessary for maintaining the coke at a sufficiently high temperature for permitting decomposition of steam, *i.e.*, about five minutes. During the first period the device acts like a Siemen's gas-producer, and permits the disengagement of a carbonic oxide and nitrogen compound, which can be afterwards utilised, for instance for heating the air and producing the necessary steam. During experimental tests made at Warstein, Westphalia, with Essen gas-coke containing about 87·56 per cent. of carbon, 2·56 cubic metres (90·4 cubic feet) of water-gas were obtained per kilogramme (2·2lbs.) of coke. This, taking the coke used for heating the air and furnishing the steam, into account, would be reduced to 2·15 cubic metres (75·9 cubic feet). This is about double the quantity of gas obtained by other methods, having a density of 0·5365 and a calorific power of 4,089 calorics per kilogramme (7,360 British thermal units per lb.) and consisting of hydrogen 0·75, nitrogen 3·93, and various other gases 0·88 per cent.

The Source of Energy for the Becquerel Rays.—"The question as to the origin of the energy possessed by the Becquerel rays," says *Nature*, "is one of considerable interest. The existence of substances capable of emitting radiations possessing energy, without any appreciable loss of weight or introduction of work from external sources, would appear to be impossible from the view of conservation of energy. The measurements of M. Henri Becquerel upon the deviation of the radium rays in an electric field, taken in conjunction with those of M. and Mme. Curie of the charges carried by these rays, lead to results which show a way out of this difficulty, on account of the extreme minuteness of the qualities of energy in question. The calculations of M. Becquerel show that the energy radiated per square centimetre is of the order of one ten-millionth of a watt per second. Hence a loss of weight of about a milligram in a thousand million years would suffice to account for the observed effects, assuming the energy of the radium to be derived from an actual loss of material."

The Welsbach Mantle.—Scientific experiments seem to show that of all artificial lights the Welsbach light is the most effective: "All artificial lights," says a contemporary, "even the best, are extravagantly wasteful of energy, in that they lavish it in the infra-red, and not in the visible spectrum. Mr. C. G. Abbot, who has charge of the Astrophysical Observatory of the Smithsonian Institution, has examined the light emitted by the Welsbach mantle (which consists of impure thorium oxide) and other incandescent mantles, by means of the bolometer, with a view of comparing their efficiencies. Though the illuminating powers differ considerably, the distribution of energy is much less diversified than would be supposed, and shows clearly the wastefulness even of the Welsbach light as a source of illumination. The infra-red in each case includes by far the greater portion of the energy, and not the visible spectrum, as is the case with the sun, and still more, with phosphorescent substances. Excluding the infra-red radiation, the Welsbach mantle was found to be superior in light to the others experimented with, especially in the red, orange and yellow parts of the visible spectrum."

Protection against Torpedoes by Armour-Plates.—It is stated that two of the Russian battleships, the *Borodino*, under construction at

the admiralty docks in the Neva, and the *Orel*, being built on "Galley's Island" at St. Peterburg, will be provided with a plate-armour screen as a protection against torpedoes. This screen is to have a thickness of 3·7 cm. The *Cesarevitch*, also under construction at St. Petersburg, will receive only the usual net-protection of the Bullivant type, which, by the way, has been abandoned in the French navy. The plate-armour protection screen for the two other vessels is probably of the type devised by Dr. G. Horatio Jones, which has also been tried it is said, in our navy, and there was a rumour that the *Canopus* is provided with it. The *Canopus*, however, has meanwhile joined the Mediterranean squadron and carries the Bullivant net, with a few improvements which were first tested on the *Mars* of the Channel Squadron, and permits a more speedy letting down and drawing in of the net. The plate-protector of the Jones type consists of steel plates tightly fitting the walls of the vessel and when pushed forward for protection form at a distance of 4·6 in. a kind of exterior wall, against which the torpedo will explode without injuring the ship. This protecting screen turns on a hinge and is pushed out by trusses fastened to the davits. It is stated that the pushing out does not require much time and the withdrawal can be performed in an instant, as it is merely necessary to withdraw the supporting trusses and to let the screen fall back. There are, however, many objections to this means of protection, above all the liability of the screen to bend if not carefully handled, which would render it a serious impediment to speed.

Canadian Tariffs.—As the Canadian Government has still further increased the preferential rebate in favour of British manufactures from 25 per cent. to 33⅓ per cent., this offers a unique opportunity to British manufacturers of machinery of all kinds. Very little machinery is manufactured in Canada, and a 33⅓ per cent. rebate enables us to successfully compete with any American manufacturer. The demand for boilers of all kinds, stamp mills, ore cars, belting, &c., crushers, buckets, wire cables, drills, dynamo hoisting engines, turbines, &c., extends from Klondyke to Atlin, throughout British Columbia, which is one vast mineral deposit, to the North-West Territory, and again to Ontario, with great free milling quartz deposits, to Quebec and Nova Scotia. Very large iron and steel works are now in contemplation in Eastern Canada. The great collieries of Eastern Canada provide a constant and increasing demand for many kinds of machinery. Saw mills, pulp mills, electric power and light works can be supplied now from this side at a good profit. In a recent issue the *British Columbia Review* published a note from its Toronto office, which stated that Canadian mining machinery firms are refusing to guarantee delivery in less than from four to six months after order. The importance of this 33⅓ per cent. rebate on the duty is so obvious, in view of the immense mining and industrial development of Canada, that those who enter the field now will have an immeasurable advantage over those who follow later.

An Ice Factory for Manchester.—A number of prominent Manchester men interested in the wholesale fish market have decided to manufacture their own ice, and to lay down a plant for that purpose. They have issued a prospectus dealing with the subject, and announced the formation of the Crystal Ice Company, Limited. Of especial interest is the fact that the company will establish waterworks of its own, and it is stated that water-bearing rocks underlie the site acquired for the factory that will yield, after the boring, 12,000 gallons per hour at a cost of a penny per thousand, which is quite a contrast compared with the price of the Manchester Corporation, which charges 4½d. per thousand. The capacity of the ice-plant is estimated at fifty tons of ice every twenty-four hours.

American Manufactures for India.—Consul-General Patterson reports from Calcutta under date of January 25, 1900: "I am constantly receiving letters regarding the manufactures of the United States, inquiring how such manufactures can be procured, and requesting to be put in communication with our exporters. The imports into India last year amounted to about $270,000,000, and this is the great distributing point. The National Association of Manufacturers of the United States is doing efficient and practical work in the way of extending the foreign trade of the United States by establishing warehouses at Caracas, Venezuela, and Shanghai, China, for the display and sale of goods made by members of the association. I have no doubt that if such a warehouse were established in Calcutta, with agents authorised to make sales, a very large trade would result."

German Commercial Museum.—There is no doubt that Germany is in earnest in pushing her Eastern trade. The most recent enterprise for this object is the establishment of an Oriental Commercial Museum at Berlin for the double purpose of establishing a permanent exposition of samples on the plan of the Philadelphia Commercial Museum and of serving as a chamber of commerce in promoting trade between Germany and the East.

Erratum.—It was stated in last issue that the diameter of the largest gasholder in the world, constructed by Messrs. Clayton, Sons & Co., Ltd., of Hunslet, was 293 feet diameter, whereas it is 300 feet diameter.

In this section is presented every month a concise précis of the contents of the leading organs of the technical press and of the proceedings of learned societies throughout Great Britain, the Continent, and America, and also, in a summarized form, the subject matter of the more important articles appearing therein.

This systematic record should prove of the greatest value to those of our readers interested in one or more specific sections of technology, trade or economics, or to those who have insufficient leisure to peruse the large number of publications now appearing.

The following is an Index to the abbreviations used throughout the section. It gives an alphabetically-arranged list of the publications regularly reviewed, together with the place of publication and price. Should any of our readers desire further information we shall be happy to supply it.

Advertisers' Review	London	1d.	*Ad. Rev.*
American Machinery	New York	10c.	*Am. Machy.*
American Machinist	New York	6c.	*Am. Mach.*
American Manufacturer & Iron World	Pittsburg	$4 yr.	*Am. Mftr. and Ir. Wld.*
American Shipbuilder	New York	10c.	*Am. Shipbldr*
Annales des Ponts et Chaussées	Paris		*Ann. des Pts. et Chauss.*
Architect	London		*Archt.*
Architectural Record	New York		*Arch. Rcd.*
Architectural Review	Boston U.S.A.	1s.	*Arch. Rev.*
Arms & Explosives	London	6d.	*Arms and Exp.*
Australian Mining Standard	Sydney	6d.	*Aust. Min. Stand.*
Australian Trading World	London	2d.	*Aust. Trdg Wld.*
Automotor and Horseless Vehicle Journal	London	6d.	*Autom. and Horsel. Veh. Journ.*
Berg und Hüttenmannische Zeitung	Berlin		*Berg Hüttenm. Ztg.*
Board of Trade Journal	London		*Board of Tr. Journ.*
Book & News Trade Gazette	London	1d.	*Bk. and Nws.. Trd. Gaz.*
British Architect ...	London	4d.	*Brit. Archt.*
British & Colonial Druggist	London	10s. yr.	*Br. and Col. Drgst.*
British & Colonial Printer	London	2d.	*Bri. and Col. Prtr.*
British Printer ...	Leicester	1s.	*Br. Prtr.*
Builder	London	4d.	*Bldr.*
Builders' Journal	London	1d.	*Bldr's Journ.*
Bulletin de la Société d'Encouragement	Paris		*Bull. d. l. Soc. d'Encour.*
Canadian Architect	Toronto		*Canad. Archt.*
Canadian Electrical News	Toronto		*Canad. Elec. News.*
Canadian Engineer	Montreal		*Canad. Engr.*
Canadian Manufacturer	Toronto	8s. yr.	*Can. Mftr.*
Canadian Mining Review	Ottawa		*Canad. Min. Rev.*
Carriage Builders' Journal	London	10s. yr.	*Carr. Bldrs'. Journ.*
Chamber of Commerce Journal	London	1s.	*Chamb. of Com. Journ.*
Chemical Trades Journal	Manchester	4d.	*Chem. Trds. Journ.*
Coach Builders' Art Journal	London	25s. yr.	*Coachbldrs'. Art Journ.*
Cold Storage ...	London	6d.	*Cold Storage*
Colliery Guardian	London	6d.	*Coll. Guard.*
Commerce	London	6d.	*Comm.*
Commercial Intelligence	London	1d.	*Com. Int.*
Comptes Rendus de l'Acad. des Sciences	Paris		*Compt. Rend.*
Compte Rendu de la Société des Ingénieurs Civils	Paris		*Compt. Rend. des Ing. Civ.*
Contract Journal	London	6d.	*Contr. Journ.*
Deutsche Techniker Zeitung	Berlin	9 mk. 25 pf. yr.	*Deutsch. Techn. Ztg.*
Dingler's Polytechnisches Journal	Stuttgart		*Dingler's Polyt. Journ.*
Diplomatic & Consular Reports	London & Washington		*Dipl. and Cons. Rpts.*
Echo des Mines ...	Paris & Brussels	40 fr. yr.	*Ech. d. Mines*
Eclairage Electrique	Paris		*Ecl. Elect.*
Electrical Engineer	London	3d.	*Elec. Engr.*
Electrical Engineering	Chicago		*Elec. Engrg.*
Electrical Review ...	London	4d.	*Elec. Rev.*, London
Electrical Review ...	New York	10c.	*Elec. Rev.*, New York
Electrical World ...	New York	10c.	*Elec. Wld.*
Electrician	London	6d.	*Electn.*
Electricien	Paris		*Electn.*, Paris
Electricity	London	1d.	*Electy.*, London
Electricity	New York	10c.	*Electy.* New York
Elektrochemische Zeitschrift	Berlin		*Elektrochem. Ztschrft.*
Elektrotechniker	Vienna	12 mk. yr.	*Electrotechniker*
Elektrotechnische Zeitschrift	Berlin		*Elektrotech. Ztschr't.*
Elettricita	Milan		*Elettricita*
Engineer	London	6d.	*Engr.*
Engineer	Cleveland U.S.A.	5c.	*Engr.*, Cleveland
Engineering ...	London	6d.	*Engrg.*
Engineering and Mining Journal	New York	15c.	*Engrg. and Min. Jour.*
Engineering Magazine	New York & London	1s.	*Engrg. Mag.*
Engineering News	New York	15c.	*Engrg. News.*
Engineering Record	New York	12c.	*Engrg. Rcd.*

English & Amer. Gazette	Paris	20c.	*Engl. and Am. Gaz.*
English Mechanic	London & New York	2d.	*Engl. Mech.*
Gas Engineers' Magazine	Birmingham	6d.	*Gas Engrs. Mag.*
Gas World	London	6d.	*Gas Wld.*
Gaz, Le	Paris	1 *fr.*	*Gaz*
Génie Civil	Paris	1 *fr.*	*Gén. Civ.*
Gesundheits-Ingenieur	Munchen		*Ges. Ing.*
Glaser's Ann. f. Gewerbe und Bauwesen	Berlin		*Glaser's Ann.*
Hardware, Metals & Machinery	London	5s. 9*d.*	*Hrdw., Mets. and Machy.*
Hardware Trades Journal	London	6d.	*Hrdw., Trds Journ.*
Heating & Ventilating	New York		*Heatng. and Venting.*
Ice & Cold Storage	London	6d.	*Ice and Cld. Storage.*
Illustrated Official Journal of Patents	London	6d.	*Ill. Off. Journ. of Pat.*
Indian & Eastern Engineer	Calcutta	R1.	*Ind. and East. Engr.*
Indian Engineering	Calcutta		*Ind. Engrg.*
Industrie Electro Chimique	Paris	60c.	*Ind. Elec. Chim.*
Industries & Iron...	London	4d.	*Ind. and Ir.*
Invention	London	1d.	*Inv.*
Irish Textile Journal	Belfast	11s. 6*d.* yr.	
Iron Age	New York		*Ir. Age.*
Iron and Coal Trades Review	London	6d.	*Ir. and Coal Trds. Review*
Iron and Steel Trades Journal	London	3d.	*Ir. and Steel Trds. Journ.*
Ironmonger ...	London	6d.	*Irnmgr.*
Journal of the Chemical Society	London	30s.	*Jrn. Chem. Soc.*
Journal of Commerce	Melbourne	15s.	*Journ. of Comm.*
Journal of Electricity	San Francisco		*Jour. of Elec.*
Journal of Electricity Power and Gas	San Francisco	10c.	*Journ. of Electr. Power and Gas*
Journal of Gas Lighting	London	6d.	*Journ. of Gas Lghting.*
Journal Inst. Elec. Engrs.	London		
Journal of Royal Inst. of British Architects	London	1s.	*Journ. of Roy. Inst. of Br. Archts.*
Journal of State Medicine	London	2s.	*Journ. of State Med.*
Journal of the Society of Arts	London	6d.	*Journ. of Soc. of Arts*
Knowledge	London	6d.	*Knowl.*
Laundry Journal ...	London	1d.	*Ldry. Journ.*
Laundry Record ...	London	4d.	*Ldry. Rec.*
Lightning	London	2d.	*Lghtng.*
Literary World ...	London	1d.	*Lit. Wrld.*
Locomotive Engineering	New York	20c.	*Locom. Engrg.*
Locomotive Magazine	London	2s. 6*d.* yr.	*Loc. Mag.*
Machinery	London	8s. 6*d.*	*Machinery,* London
Machinery	New York		*Machinery,* New York.
Machinery Market	London	6d.	*Mach. Mark.*
Manufacturer ...	Philadelphia	$5 yr.	*Mfrr.*
Marine Engineer ...	London	6d.	*Mar. Engr.*
Marine Engineering	New York	6d.	*Mar. Engrg.*
Mechanical Engineer	Manchester	6d.	*Mech. Engr.*
Mechanical Progress	M'chr	3d.	*Mech. Prog.*
Mechanical World	London	1d.	*Mech. Wrld.*
Metallurgie ...	Paris	22*fr.*	*Metall.*
Miller	London	5d.	*Miller*
Mining Journal ...	London	6d.	*Min. Journ.*
Mining World ...	London	6d.	*Ming. Wld.*
Mitt. aus d. Kgl. Tech. Versuchsanst	Berlin		*Mitt. a. d. Kgl. Tech. Versuchsanst,* Berlin.
Modern Machinery	Chicago	$1	*Mod. Machy.*
Mois Scientifique	Paris	$1.50	*Mois. Scient.*
National Laundry Journal	Chicago	15c.	*Nat. Ldry. Journ.*
Nature	London	6d.	*Nature*
Nature	Paris		*Nature,* Paris
Nautical Gazette ...	New York	10c.	*Naut. Gaz.*
Oest. Monatsschr f. d. Oeff. Baudienst	Vienna		*Oest. Monatsschr. f. d. Oeff. Baudienst*
Oest. Zeitschr. f. Bergund Hüttenwesen	Vienna		*Oest. Zeitschr. f. Berg u. Hüttenwesen.*
Paper & Pulp ...	London	6d.	*Pap. and Plp.*
Power...	New York	10c.	*Power*
Practical Engineer	London	2d.	*Pract. Engr.*
Proceedings, Am. Soc. of Civil Engineers	New York	$6	*Proced. Am. Soc. Civ. Engrs.*
Public Health Engineer	London	3d.	*Pub. Hlth. Engr.*
Railway Engineer	London	1s.	*Rail. Engr.*
Railway and Engineering Review	Chicago	$5	*Rail and Engng. Rev.*
Railway Magazine	London	6d.	*Rail. Mag.*
Railway Master Mechanic	Chicago	$1.50	*Railw. Mast. Mech.*
Railway News ...	London	6d.	*Rail. News*
Railway Official Gazette	London	1d.	*Rail. Off. Gaz.*
Railway Record ...	London	6d.	*Rail. Rcd.*
Revista Minera ...	Madrid	25*fr.*	*Rev. Min.*
Revue de Chimie Industrielle	Paris	15*fr.*	*Rev. d. Chim. Ind.*
Science Abstracts	London & New York	2s.	*Science Abstr.*
Scientific American	New York	$4 yr.	*Sci. Am.*
Scientific American Supplement	New York	$5 yr.	*Sci. Am. Suppl.*
Shipping World ...	London	6d.	*Shpng. Wrld.*
South Africa ...	London	6d.	*South Afr.*
Stahl und Eisen ...	Dusseldorf	24 *mk.* yr.	*Stahl u. Eisen*
Steamship	Leith	6d.	*Steamsh.*
Stone	New York		*Stone*
Surveyor	London	6d.	*Survr.*
Syren	London	3d.	*Syr.*
Textile Industries	Bradford	10s. yr.	*Text. Ind.*
Textile Mercury ...	Manchester	1d.	*Text. Merc.*
Textile Recorder ...	Manchester	12s. yr.	*Text. Rcdr.*
Textile-Zeitung ...	Berlin	16 *mk.* yr	*Text. Ztg.*
Trade & Finance ...	London	1d.	*Trde. and Fin.*
Trade & Industry...	Manchester & London	6d.	*Trde. and Ind.*
Trade Journals Review	London	6d.	*Trde. Journ. Rev.*
Tramway & Railway World	London	1s. 3*d.*	*Tramw. and Railw. Wld.*
Transactions of the Inst. of Naval Architects			
Trans. Inst. Engrs. & Shipbuilders	Glasgow		
Trans. Soc. Engrs.			
United Service Magazine	London	2s.	*Un. Ser. Mag.*
Western Electrician	Chicago	10c.	*West. Electn.*
World's Pulp and Paper Industry	London	6d.	*Wld's Pulp and Ppr. Ind.*
Zeitschr. d. Oest. Ing. u. Arch. Vdr.	Vienna	30 *fr.* yr.	*Ztschrft. d. Oest. Ing. u. Arch. Ver.*
Zeitschr d. Ver. Deutscher Ingen.	Berlin		*Ztschrft. d. Ver. Deutsch. Ing.*
Zeitschrift für Elektrochemie	Halle a. S.	16 *mk.* yr.	*Ztschrft. f. Elektrochem.*
Zeitschrift für Elektrotechnik	Halle a. S.		*Ztschrft. Elektrotech.*

ARCHITECTURE AND BUILDING.

1. Construction and Design.

Acoustics.—*Architectural Acoustics.* By Prof. Wallace E. Sabine, Harvard University. The author gives the conclusions, at which he has arrived, after experiments lasting over two years, for the purpose of remedying the acoustics in the lecture room of the Foggart Museum of Harvard University, and of later studies made in connection with the building of a new Boston music hall. The paper is intended to be, as the author says, introductory to the general subject of architectural acoustics and immediately to a series of articles dealing with the subject of reverberation, and is a valuable addition to the comparatively limited literature on the science of sound as applied to buildings. 5½ cols.—*Engng. Rcd.*, April 14th, 1900.

A Palace Structure.—*A Japanese Imperial Palace.* Summary description of the structural details of a large palace for the Crown Prince of Japan, the steel framework of which is designed by American engineers and manufactured by American manufacturers. Its interest lies above all in the special details designed to meet the conditions of a country which is subject to 300 earthquakes every year. 3½ cols.—*Engng. Rcd.*, April 7th, 1900.

Arch Construction.—*A Great Arch, Cathedral of St. John the Divine.* The cathedral referred to occupies a commanding position near Morningside Park, in New York, on the Hudson River, and when completed will be 520 × 296 ft., having a spire 450 ft. high above the main floor. The tower will rest on four granite arches arranged in a 130 ft. square and acting as the directives of a groined vault. The article deals with the great arches, the springing line of which will be 16 ft. above the tops of the 70 ft. piers and which will have a span of 117 ft. out to out of voussures, and 86 ft. clear. (Ill.). 3½ cols.—*Engng. Rcd.*, March 31st, 1900.

Central Stations.—*Central Stations.* By C. Stanley Peach, F.R.I.B.A. Abstract of a paper read at Carpenters' Hall, March 1st, 1900. The author deals with the architectural and structural features of central stations for electricity supply. 3½ cols. and 5 cols. respectively.—*Contract Journ*, March 14th and 21st, 1900.

Column Resistance.—*The Practical Column under Central and Eccentric Loads.* Paper by J. M. Moncrief, M. A. Soc. C.E. A new attempt to find formulas providing means of predicting or estimating the probable strength of columns as affected by their proportions. 10¼ cols.—*Proc. Am. Soc. C. E.* March, 1900.

Metal Work in Buildings.—*Metal Work details of the Paris Exhibition Buildings, Paris.*, I., II., III., and IV. This series of articles describes the details of the metal framework in the Civil Engineering and Transportation building, the Textile Palace, the Machinery Palace the Palace of Chemical Industries, and the Palace of Mines and Metallurgy. To be continued. 3, 3, 5 and 3¾ cols. respectively.—*Engng. Rcd.*, March 17th, 24th, 31st and April 7th, 1900.

Reconstruction.—*Street Front Reconstruction.* The article describes the means employed for replacing the masonry walls in a Toronto building with steel columns on the same foundations. ¾ col.—*Engng. Rcd.*, Feb. 10th, 1900.

—— *Reconstruction of the Manhattan Bank Building.* The article gives a full account of the repairing and strengthening of an office building seriously damaged by fire, describing the strengthening of the foundations and columns and the laying down of fireproof floors, 1¾ col. *Engng. Rcd.* Feb. 3rd, 1900.

Steel Stand.—*A Large Steel Grand Stand.* Description of a large stand erected at Yonkers, N.Y., having a length of 400 ft. and width of 62 ft., with seats for 7,700 spectators. The article contains the structural details of the columns and roof connections, with a detailed explanation of other structural features. *Engng. Rcd.*, Feb. 10th, 1900.

Supporting Columns.—*The Design of Columns for Sheds exposed to Wind and of Concrete Boxes.* By Leopold Measch. Mathematical computations for concrete boxes and for the design of structures such as freight and passenger sheds. 1¼ col.—*Engng. Rcd.*, Feb. 1st, 1900.

2. Heating, Ventilation and Sanitation.

Heating and Ventilation.—*Ventilation and Heating of the Nashville Union Station.* The article deals with an original kind of plant supplying a building 145 × 149 ft., and five stories. 4½ cols.—*Engng. Rcd.*, Feb. 24th, 1900.

Ventilation.—*Ventilation of Large Buildings.* By Mervyn O'Gorman. Abstract of paper read before the Civil and Mechanical Engineers' Society, London, March 1st, 1900. 5¾ cols.—*Contract Journ.*, March 21st, 1900.

Steam Heating.—*The Distribution of Steam at Dartmouth College.* The article deals with the details of a steam heating plant laid down in 1898 in Dartmouth College, in Hanover, N.H., U.S.A., the study of which is of practical value where long lines of piping are projected. (Ill.). 4 cols.—*Engng. Rcd.*, March 31st, 1900.

3. Plumbing and Gasfitting.

Plumbing.—*Plumbing in the Broadway Chambers Building in New York.* Short description of the plumbing, comprising only what is necessary for the office wash basins, public toilet rooms, janitor's and engineer's service, etc., in the new office building at Broadway and Chambers Street, New York, which has eighteen stories, basement and cellar. 1¾ cols.—*Engng. Rcd.* April 7th, 1900.

4. Miscellaneous.

Building Stones.—*Building Stones around Liverpool.* By Ernest C. Aldridge. The author deals with the subject in connection with the geological features of the district. Pt. II. by Mr. A. W. Street deals with the limestones, granites and marbles from all parts of the world that are used in and around Liverpool for building purposes. 8¾ cols.—*Bldr's Journ. and Arch. Rcd.*, April 18th, 1900.

Seasoning of Timber.—*The Nodou-Britonneau Process of Seasoning and Preserving Timber and other Fibrous Substances by Electricity.* By E. G. Vere Vecqueray. Abstract of a paper read before the Institution of Mining Engineers. 2½ cols.—*Contract Journ.*, March 14th, 1900.

II. CIVIL ENGINEERING.

1. Bridges.

Bridges.—*Rolling Lift Bridge at the Boston Terminal, (N.Y., N.H., and H.R.R.)* The article describes a bridge of the type devised by Scherzer, M. Am. Soc. A. E., who died in 1895. In these bridges each span or half-span rolls back upon its curved heel, laid on a track laid on the abutment. The total width of the channel, between harbour lines is 270 ft, but there are six piers, three on each side of the 42 ft. navigable channel. The total weight is 4,685,000 lbs., of which 1,755,000 lbs. are counterweight metal. (Ill.). 5 cols.—*Engng. News*, March 15th, 1900.

—— *Mason Work on the New East River Bridge Anchorages* The New York Anchorage of the New East River bridge, is designed to secure the ends of the four main cables, each 17⅞ inches in diameter and of an estimated ultimate strength of 40,000,000 pounds. The assumed maximum vertical reaction of 14,800,000 pounds is resisted wholly by the superimposed masonry, which is calculated to have an effective weight of 206,000 pounds. The entire mass of masonry of all classes in this anchorage is about 45,000 cubic yards, and with the superimposed steel work and grillage, will impose a total weight of 254,000,000 pounds. The article deals fully with the construction of this masonry. (Ill.). 3 cols.—*Engng. Rcd.*, April 7th, 1900.

—— *The Kaisersteg Bridge.* By H. Muller of Breslau. Extract translated from an article in the *Zeitschrift für Bauwesen*, describing a 573 ft. cantalever bridge with a centre hinge and stiffening arch, in which the curves of the chords were calculated by an original method, set forth in detail. 1¼ col.—*Engng. Rcd.*, Feb. 17th, 1900.

—— *Hinged Concrete Arched Bridge over the Neckar River at Kirchheim, Wurtemburg.* Short description of one of

the most notable bridges of the hinged concrete arch type, which has been recently constructed in Europe. (Ill.). 1½ col.—*Engng. News.*, March 29th, 1900.

Bridges.—*The Great Northern Railway—Bridges over the River Aire.* Detailed description of a very interesting engineering work. 3 cols.—*Engr.*, April 20th, 1900.

—— *Arched Bridges over the Rhine.* Description of two noteworthy bridges over the Rhine. The first instalment of the article describes the bridge over the Rhine. 2½ cols.—*Engng.*, Feb. 9th, 1900.

—— *Flood Damage to the Hudson River Passenger Bridge and Station of the Delaware and Hudson Railway at Albany, N.Y.* The article describes the damage caused by the flood to the structures mentioned and to the property concerned in general. 1½ cols.—*Engrg. News*, Feb. 22nd, 1900.

—— *Operating Mechanism, Duluth and Superior Swing Bridge.* The article describes the electrical apparatus employed for moving and locking a swing span, having a weight of 2,000 tons. 2¾ cols.—*Engng. Rcd.*, Feb. 24th, 1900.

—— *Graphical Determination of the Pier Reaction of Continuous Girders of a Constant Moment of Inertia.* By L. Geusen. The article is accompanied by diagrams adapted to a great number of cases occuring in practice. 4½ cols.—*Ztschrft d. Oest. Ing. u Arch. Ver.*, Feb. 2nd, 1900.

Portable Pile Driver.—*A Portable and Collapsible Pile Driver.* Contribution describing a pile driver with 40 ft. leads suitable for working vertical or inclined piles on the sides or ends of its cars which can be closely folded up for transportation. 1¼ cols.—*Engng. Rcd.*, Feb. 17th, 1900.

2. Canals, Rivers and Harbours.

Canals.—*The New Inland Waterway.* By J. A. Stewart. The author discusses the technical details of constructing the Chicago drainage Canal, and gives an account of the reasons for building it (Ill.). 3½ cols.—*Sci. Am.*, Feb. 17th, 1900.

—— *Ten Years Progress of British Canals.* By W. B. Paley. Digest of the very interesting return lately published under the provisions of the Railway and Canal Traffic Act, 1888, being a report of the traffic, capital, and works of the entire canal system of the United Kingdom, including also the navigable rivers. 2 cols.—*Mech. Wrld.*, April 27th.

Cleansing of Lakes and Rivers.—*Newman's Patent Silt and Mud Removing Scoop.* Account of a scoop in operation near Stansted, Essex, designed and manufactured by Mr. T. O. Newman in Stansted, Essex, and said to combine the advantages without the attendant disadvantages of other scoops (Ill.). 1½ cols.—*Contr. Journ.*, April 11th, 1900.

Dams.—*The Effect of Damming the Niagara River Upon the Levels of the St. Lawrence River.* Discussion of the probable effect of the proposed damming of the Niagara River for regulating the level of Lake Erie, which has aroused the concern of Canadians for the preservation of the navigable water ways of Lake Ontario and the St. Lawrence River, accompanied by the suggestion that the Canadian Government should cooperate in devising means for rendering the project profitable to both countries. 5¾ cols.—*Engng. Nws.*, March 22nd, 1900.

—— *The Failure of the Austin Dam.* The failure of the Austin Dam, which occurred on April 7th, this year, brings to an end one of the most noteworthy experiments in municipal trading in the United States. About 10 years ago, the late John McDonald, a well-known contractor of the south west, and a number of leading citizens of Austin, Texas, decided to dam the Colorado River (which at low water has an estimated flow of 1000 cubic ft. per second, and a maximum flow of 250,000) near the city, and use the water thus stored for a power plant. Enormous sums were spent, but scarcely any benefit was obtained and the recent breakdown ends the enterprise. The present article contains a review of the history of the undertaking and describes the nature of the failure of the works (Ill.). 4 cols.—*Engng. Rcd.*, April 14th, 1900.

Isthmian Canal.—*The Proposed Neutralization of the Isthmian Canal.* Editorial arguing in favour of the neutralization by international agreement of the contemplated canal across the American Isthmus. 3½ cols.—*Engng. News*, Feb. 22nd, 1300.

3. Irrigation.

4. Miscellaneous.

Physical Properties of Quicksand.—*Quicksand.* Essence of the professional opinions of a number of engineers, together with an analysis of the physical properties of quicksand and a determination of its nature. 2¾ cols.—*Engng. Rcd.*, Feb. 10th, 1900.

ELECTRICAL ENGINEERING.

1. Electro-Chemistry.

Electro-Chemistry.—*On a Test, by the Freezing Point Method, and the Ionization Coefficients, determined by the Conductivity Method, for Solutions containing Potassium and Sodium Sulphates.* By E. H. Archibald, M.Sc. *Proc. & Trans. Nov. Scot. Inst. of Sc.* Vol. X., Pt. I.

Electrolysis.—*Two New Forms of Mercury Cell for the Electrolytic Production of Alkalies and Chlorine.* By John B. C. Kershaw, F. I. C. The article deals first with the Rhodin cell, the development of which in England is, for the time being, blocked by the infringement proceedings inaugurated by the Castner-Kellner Company, owners of the Kastner cell; it is, however, to be worked on an industrial scale in the United States. The second cell described is the invention of Mr. J. W. Kynaston of Liverpool, and is protected by the British Patent No. 15,967 of 1898 (Ill.). 2½ cols.—*Elec. Rev.*, April 13th, 1900.

Electro-Metallurgy.—*Electro-Metallurgy in Europe in 1899.* By B. C. Kershaw. The author deals with the development that some of the older industries have undergone during the year and some new processes that have left the experimental stages, under the headings of the various metals or compounds. 4 cols.—*Electricity* (New York), April 11th, 1900.

Galvanic Cells.—*Energy Losses in Galvanic Cells—Their Cause and Prevention.* By G. Warren. The author points out how little progress has been made in the construction of efficient galvanic batteries and then enters upon an investigation of the defects of existing cells as a basis for improvement. (To be continued.) 2½ cols.—*Electricity* (London), April 13th, 1900.

2. Electric Lighting.

Electrical Lamps.—*"Wood" New Focusing Series Arc Lamp.* Description of a new type of arc lamp, which has the arc always at the same point, where it gives a maximum illumination during the full life of the carbon, and in which for this object the focusing mechanism is entirely distinct and in no sense a part of the feeding mechanism (Ill.). 2 cols.—*Elect. icity* (New York), April 18th, 1900.

Electric Lighting.—*Cost of Lighting by Private Installations v. Public Supply Companies.* A comparison between private installations and of those in which the current is taken from the company or corporation's mains, giving an estimate of the relative cost in each case, together with the advantages and disadvantages of each system. 1½ col.—*Engr.*, April 20th, 1900.

—— *The Electric Lighting of St. Petersburg.* During the last two years the use of electricity in the Russian capital has greatly increased, and three companies have erected stations, namely, Siemens & Halske, Helios, and Electricité et Hydraulique de Charleroi. The article describes the central station and plant of the latter (Ill.). 2½ cols. and 2 cols. respectively.—*Elec. Rev.* (London), April 8th and 13th, 1900.

Electric Wiring.—*The Electric Wiring of Buildings.* By W. A. Chamon. Abstract of a paper read before the Institution of Engineers and Shipbuilders in Scotland, Jan. 23, 1900, describing India-rubber insulated wires running in wood casings causes of accidents and prevention in the lead-covered cable system, iron-tube systems, the prevention of accidents in iron-tube systems, the tree-system of wiring, the distribution board-system, &c., accompanied by diagrams. 4½ cols. and 3¾ cols., respectively.—*Mech. Engr.*, March 31st, 1900.

Fuse Devices.—*The Evolution of Safe and Accurate Fuse Protective Devices.* By Joseph Sachs. The author

describes a number of experiments made with the object of producing a protective device which could lay claim to safety and accuracy, and a new form of protective fuse devised by him (Ill.). 4¼ cols. (To be continued.).—*Electricity* (New York), April 11th, 1900.

Lighting.—*The Elements of Illumination I.* By Dr. Louis Bell. This is the first of a series of articles in which the author attempts to set forth some of the fundamental principles, optical, physiological and æsthetic, which underlie the proper use of artificial illuminants and to point out how they may be adapted to present conditions. 3 cols.—*Elec. Wrld. & Engr.*, April 14th, 1900.

3. Power.

Accumulators.—*A Method of Determining the True Surface of Accumulator Plates.* By Conrad Norden. The author describes a method for determining the effective area of any form of accumulator plate by the volume of current yielded, and showing how to apply the data thus obtained. 6¼ cols.—*Ztschrft f. Elektrochemie.*, Feb. 1st., 1900.

Accumulator Plates.—*Experiments with Accumulator Plates.* Digest of an article by Mr. Franz Peters. Published in the "Centralblatt für Accumulatoren und Elementenkunde" describing some experiments with positive accumulator plates, which have become soft. 1¾ col.—*Elec. Engr.*, April 20th, 1900.

Alternating Machines.—*Hunting of Alternating Current Apparatus.* By H. W. Buck. The author deals with the annoying mechanical oscillation, known as "hunting," to which alternating current generators are subject, and will be subject, as long as steam engines are used as prime-movers. 2½ cols.—*Elec. Wrld. and Engr.*, April 7th, 1900.

Asymetrical Currents.—*The Production of Asymetrical Alternating Currents, by means of Electrolytic Polarization—I.* By W. L. Hildburgh. This is the first of a series of articles dealing with asymetrical conductors when action depends on counter e.m.f's. produced by electrolysis, some of them previously known, some original with the writer, and being a condensation of a thesis submitted for obtaining the degree of Doctor of Philosophy in the School of Applied Science of Columbia University. 4 cols.—*Elec. Wrld. and Engr.*, April 14th, 1900.

Central Stations.—*American Central Station Design.* The article deals with a typical example of the practice in designing large electrical generating stations in the United States, namely the new station on the water-front of the East river, of the Metropolitan Street Railway Company of New York. (Ill.). 1½ cols.—*Elec. Engr.*, April 6th, 1900.

Conduit Pipes.—*Description on the Flow of Water in the six-foot Steel and Wood Pipe Line of the Pioneer Electric Power Company, at Ogden, Utah, U.S.A.* A paper presented by Messrs. Charles D. Marx, Charles B. Wing, and Leander M. Hoskins, Civil Engineers. (Ill.). 19¾ cols.—*Proc. Am. Soc. C. E.*, February, 1900.

Cranes.—*150-Ton Electric Crane at the Imperial Dock in Bremerhaven, Germany.* Summary of an article translated from the *Zeitschrift d. Vereins deutscher Ingenieure*, describing the structural details of the largest crane in the world. 4 cols.—*Engng. News*, Feb. 8th, 1900.

—— *Electric Travelling Crane and Conveyor Plant.* Description of a crane of the jib type, constructed by Graham Morton and Co., Ltd., Leeds, mounted on a four-wheeled carriage arranged for a 4 ft. 8½ in. gauge of rails, having only one motor running at 925 revolutions per minute. (Ill.). 1 col.—*Engr.*, April 6th, 1900.

Dynamos.—*A Means of Fixing the Frequency of Inverted Rotaries.* Description of an ingenious device invented by Mr. B. G. Lamme, which has been applied in several instances by the Westinghouse Electric and Manufacturing Company. (Ill.). 2½ cols.—*Elec. Wrld. and Engr.*, April 7th, 1900.

Electrical Applications.—*Electric Distribution of Power as applied to Works and Factories.* By Geo. Harland Bowden. The author deals with the subject chiefly from the view of economy and increased efficiency, and from the not less important standpoint of increased output. (To be continued). 3½ cols.—*Elec. Engr.*, April 27th, 1900.

Electrical Fuses.—*The Evolution of Safe and Accurate Fuse Protective Devices.* By Joseph Sachs. Abstract of a paper read at the 171st meeting of the Institute of Electrical Engineers, New York, March 28th, 1900. (Conclusion). 4½ cols.—*Electricity*, April 18th, 1900.

Electric Generators.—*Test of an Electric Generating Set in the State, War, and Navy Building, Washington.* By G. W. Baird. The tests refer to a 60 Kilowatt direct-current compound condensing plant. 1⅞ col.—*Engng. Rcd.*, Feb. 17th, 1900.

—— *Large Railway Generator in Toledo.* Description of a 1050 Kilowatt Westinghouse direct-current, compound-wound generator direct connected to a 1,600 horse-power Allis vertical cross-compound, condensing steam-engine with Reynold valve gear, situated in the central power-house of the Toledo Traction Company on the bank of the Maumee River, Toledo, Ohio, U.S.A. This large generator was put on service at the end of November last, and has since carried nearly the whole of the ordinary railway load, which varies from 1,500 to 3,500 amperes. (Ill.). 1⅛ col.—*West. Elect'n.*, March 31st, 1900.

—— *The Chicago South-Side Elevated Railway Plant.* The article gives a description of the four engine-type direct-connected generators in the South-Side Elevated Railway power-station, each of which has a capacity of 800 Kilowatts, generating a current of 1,455 amperes at a potential of 550 volts; being of the 10-pole type, and weighing 135,000 pounds each. (Ill.). 2½ cols.—*Elec. Rev.* (New York), March 21st, 1900.

Electric Safety Appliances.—*The "Partridge" High Tension Safety Device.* Description of an apparatus devised by Mr. G. W. Partridge, chief engineer to the London Electric Supply Corporation, Ltd., for the protection of extra high pressure concentric mains. (Ill.). ¾ col.—*Elec. Rev.* (London), April 20th, 1900.

Electric Traction.—*The Johnson-Lundell Electric Traction Company, Ltd.* Description of the dynamos, generators, motor connections, and other technical details of the plant to be built by this new company. (Ill.). 7¾ cols.—*Elec. Engr.*, April 20th, 1900.

Electric Plant.—*The Oelwein Shops.* Description of the fine electric power distribution system of the model railway repair and machine shops of the "Maple Leaf Route," situated at Oelwein, Iowa, U.S.A. (Ill.). 6½ cols. —*Elec. Rev.* (New York), April 4th, 1900.

—— *New Electric Plant at the Blauzy Colliery.* Description of the electrical plant laid down in 1898 to supersede the compressed air plant in the Blauzy Colliery. Translated from a communication by M. Gorchat to the Société de l' Industrie Minerale, Saint-Etienne, France. (Ill.). 3½ cols.—*Coll. Guard.*, April 20th, 1900.

—— *650 K. W. Ferranti-Plenty Plant.* Description of the latest unit added to the equipment of the central station of the London Electric Supply Corporation at Deptford, which is the smallest alternator in point of output which has yet been constructed to generate current at a pressure of upwards of 10,000 volts. (Ill.). 2 cols.—*Engr.*, April 13th, 1900.

—— *The Plymouth Corporation Electric Works, Plymouth, England.* Description of the interesting plant at the Plymouth Corporation Electric Works, which were inaugurated on Sept. 22nd last year, which was the first instance of an English city laying down a plant combining both light and power. (Ill.). 4 cols. *Elec. Rev.*, March 21st, 1900.

—— *The County of London Electric Lighting Company.* Description of the plant, equipment, central stations, methods of working, &c., of the County of London Electric Lighting Company. (Ill.). 10⅛ cols.—*Elec. Wrld. and Engr.*, March 31st, 1900.

—— *A New Industrial Situation.* Summary of a pamphlet recently published by the Westinghouse interests, in which mention is made of a "30,000 horse-power gas-engine electric station, two 1,500 horse-power units of which are now under construction in the Westinghouse Machine Company's Works," together with comments on these statements. (Ill.). 5 cols.—*Power*, April, 1900.

Electric Plant.—*Doncaster Electricity Supply Works.* Description of the plant of the Municipal Electricity Works of Doncaster, inaugurated on April 2nd this year, giving first a short history of the town and of the enterprise, and then outlining the building of the central station. (To be continued). 4 cols.—*Elec. Engr.*, April 6th, 1900.

—— *Doncaster Electricity Supply Works.* (Conclusion). 3½ cols. *Elec. Engr.*, April 13th, 1900.

Electric Power.—*Electrical Driving of Factories from the Public Point of View.* By A. H. Gibbings, M.I.E.C. Abstract of a paper read before the Northern Society of Electrical Engineers, March 13th, 1900. The author, after dwelling on the importance of the use of electricity for power in factories, and the backwardness of England in such use, states that the object of his paper is to present a few facts which have been brought to light in connection with the supply of electricity for motive power purposes during a period of four years from the mains of the Bradford Corporation. 5½ cols.—*Elec. Engr.*, March 30th, 1900. Conclusion. 3 cols.—*Elec. Engr.*, April 6th, 1900.

—— *Generation of Electric Current.* The article points out that in Prussia by far the smaller portion of current generated is used for transmission, and compares the advantages of separate generation, which predominates in Germany, with central station generation, which predominates in the United States. The concluding portion is devoted to the question of accumulators, and to the resumption of the study of the secondary battery problem which has remained dormant for so many years. 2 cols.—*Elektrotechniker*, April 15th, 1900.

—— *Some Statistics regarding Electric Power Production.* By Philip Dawson. First of a series of articles attempting to show the great importance of properly laying out and working electrical stations, and describing the various methods which have been successfully used to reduce the cost of installation and production. Merely the facts are given, and it is left to the reader to make his own deductions. A comparison is attempted between the various systems to bring out the good points and bad points of each. English, American, Belgian, German, and Swiss practices are considered, and, as far as possible, compared, the conditions that obtain being taken into consideration. 3¾ cols.—*Engng.*, April 6th, 1900.

Electric Power Station.—*The Kingsbridge Power Station of the Third Avenue Railway, New York City.* By Burcham Harding. Description of a central power station, now in course of construction for the Third Avenue Ry. Co., New York City, which will contain one of the largest installations of electric current generating machinery in the world. (Ill.). 5 cols.—*Engng News*, March 22nd, 1900.

Electric Power Plant.—*Hudson River Polyphase Power Plant.* By Frank C. Perkins. Description of a power plant in operation in Mechanicsville, New York, consisting of five general electric polyphase generators in a single line each having a capacity of 750 Kilowatts. (Ill.). 1 col. *Electricity* (New York), March 21st, 1900.

Electrical Stations. *The Designing of Electrical Generating Stations.* By Alfred Roberts. Extracts from a paper by the author, read before the Society of Architects, London, and describing the general structural elements of such stations. 7¼ cols. *Mech. Wrld.*, March 30th, 1900.

Induction Motors. *850-Horse-Power Induction Motors for Moving Sidewalk at the Paris Exposition.* Description of two of the largest induction motors in existence, constructed by the Westinghouse Electric and Manufacturing Company (Ill.). 1½ col.—*West. Elect'n.*, April 7th, 1900.

Polyphase Systems. *The Polyphase Distributing System of the Metropolitan Street Railway Company of New York City. I. and II.* Full description of the purpose of the system; the provisions against danger; the electrical generator, &c. (Ill.). 1½ col. and 2 cols. respectively.—*Elec. Wrld. and Engr.*, March 31st and April 7th, 1900.

—— *The Polyphase Distributing System of the Metropolitan Street Railway Company of New York City. III.* By J. E. Woodbridge. The present instalment deals with the oil circuit breakers of an improved type. (Ill.) 4¾ cols.—*Elec. Wrld. and Engr.*, April 14th, 1900.

Power Transmission. *Power Transmission Schemes in Duluth, Minnesota, U.S.A.* By Frank W. Springer. Description of a power transmission scheme in which the watershed of western Lake Superior is to be utilised. The minimum flow in water is estimated at 15,000 h.p., which minimum flow will be augmented. (Ill.) 2 cols. —*Elec. Wrld. and Engr.*, April 14th, 1900.

Rotary Converters. *The Design of Rotary Converters.* By H. F. Parshall, M.Inst.C.E., and H. M. Hobart (continuation). The present instalment deals with the Running Conditions of Rotary Converters. 7 cols. —*Engrg.*, April 20th, 1900.

Wheel-pit. *New Wheel-pit at Niagara.* By Orrin E. Dunlop. Description of the second great Wheel-pit in the course of construction by the Niagara Falls Power Company, in which 11 turbines, each of 5,000 h.p., are to be installed. (Ill.). 3 cols.—*West. Elect'n.*, April 13th, 1900.

4. Telegraphy and Telephony.

Telegraphy. *Some New Coherer Phenomena.* Translation of an article by Signori Campanile and Di Ciommo, contributed to *L'Elettricista*, describing some highly interesting experiments undertaken with the object of obtaining information as to the nature of coherer action. 3 cols.—*Elec. Rev.* (New York), April 4th, 1900.

Telegraphy and Telephony. *The Telegraph and Telephone Lines of Austria in 1898.* Extracts from statistics published by the International Telegraph Office at Berne, Switzerland, and printed in No. 3 of the *Journal Telegraphique.* 1 col.—*Electrotechniker*, April 15th, 1900.

Telephony. *The Telegraphone.* Account of an invention by a Danish engineer, Mr. V. Poulsen, C.E., of Copenhagen, which is substantially a kind of phonograph, to be acted upon from a distance through the agency of electricity; it is to be used in combination with microphones and telephones, the sounds of a transmitter being telephoned to the telegraphone, then fixed in invisible writing by this novel apparatus, whence they again, at any time, can be reproduced in a telephonic receiver. 1 col.—*Elec. Rev.*, April 27th, 1900.

—— *The Telephone Plant of Munich.* On July 29th, 1899, the telephone plant of Munich was enlarged by the opening of a second central station and brought into harmony by the general employment of the multiplex-system. The author of the article, Mr. Aloys Nistler, gives an outline description of the full equipment of the two stations and their working. 2½ cols. —*Electrotechniker*, April 15th, 1900.

5. Miscellaneous.

Aluminium Conductors. *Aluminium Electrical Conductors.* By Frank C. Perkins. The article fully deals with the efficiency of aluminium conductors, and states that the Pittsburg Reduction Company, the principal manufacturers of aluminium in the United States, are preparing to supply a great demand. 5 cols. —*West. Elect'n.*, March 10th, 1900.

Electrical Applications. *Electric Light in Photo-Micrography.* By A. G. Scott. Description of an interesting apparatus for photo-micrography, in which the source of light is an automatic focussing arc lamp placed in nearly horizontal position, so that the major part of the light given will be projected upward to the microscope. 1½ col.—*Elec. Rev.* (New York), April 4th, 1900.

—— *The Electric Tower at the Pan-American Exposition* Description of a stately and dignified tower to be erected at Buffalo, N.Y., U.S.A., next year, on the occasion of the Pan-American Exposition, for the display of electrical decorations and as a culminating piece of the electrical display. (Ill.). 1½ col.—*Electricity* (New York), April 18th, 1900.

Electrical Units. *Electrical Standards.* The article, after a short introduction giving the history of the units of reference, describes the facilities afforded by the United States office of standard weights and measures

for the verification of electrical standards and electrical measuring apparatus. 6 cols.—*Elec. Rev.*, April 4th, 1900. Conclusion, 3½ cols.—*Elec. Rev.*, April 11th, 1900.

Electricity. *Electricity in War.* Description of the organization and equipment of the Electrical Engineer Volunteer Corps, established under the presidency of Dr. Hopkinson, by the Institution of Electrical Engineers. (Ill.). 4 cols.—*Nature*, April 5th, 1900.

—— *Electricity, its Powers and its Promises.* A popular lecture on the subject delivered at the South Shields Branch of the Ass. of Marine Engrs., on Jan. 29th, 1900, by G. A. Smith. (To be continued.). 3½ cols. *Monthly Rpt. Ass. Marine Engrs., Ltd.*, April, 1900.

—— *The Relations between Electricity and Engineering.* By Sir William Henry Preece. Abstract of the "James Forrest" Lecture, delivered before the Institution of Civil Engineers, in which the author deals with the principles underlying electrical application, the question of force, the doing of work, the purification of matter, the annihilation of space, the transmission of power, &c. —*Elec. Engr.*, April 27th, 1900.

Electro-Therapy. *The Application of Electricity in Medicine and Surgical Practice.* Abstract of a paper by Mr. H. Lewis Jones, M.D., officer-in-charge of the Electrical Department in St. Bartholomew's Hospital, before the Institution of Electrical Engineers on March 8th, 1900. (To be continued.). 4¾ cols.—*Electricity* (London). March 30th, 1900.

Lightning. *The Effects of Lightning upon Electric Lamps.* By Sidney Webb and G. J. Stokes. The authors describe photographs obtained by photographing lightning in a field including arc lamps. 4½ cols.—*Nature*, Feb. 8th, 1900.

Stray Currents. *The Action of Electric Tramway Currents on Sub-Marine Telegraph Cables and other Electric Circuits.* By Prof. Andrew Jamieson, F.R.S.E. Abstract of a paper read before the Institution of Engineers and Shipbuilders in Scotland. (To be continued.). 6¾ cols.—*Elec. Engr.*, April 6th, 1900.

MARINE ENGINEERING AND SHIPBUILDING.

Coaling Vessels. *The Miller Cableway for Coaling Vessels at Sea.* Description of an ingenious device owing its suggestion to Naval Constructor J. J. Woodward, and constructed by Mr. Spencer Miller, M. Am. Soc. C.E., and Engineer of the Lidgewood Mfg. Co. 3½ cols.—*Engr.*, April 5th, 1900.

Corrosion. *Corrosion and Failure of Propeller Shafts.* By Mr. H. Scott Younger. Abstract of a paper read before the Institution of Naval Architects, April 6th, 1900. The author endeavours to account for the extreme corrosion which is found to occur at the ends of the brass liners on tail-end shafts—thinking that the explanation usually given for this very common cause of shaft failure is not correct—and to review some of the methods that have been suggested to overcome this difficulty in hope that a full discussion of the subject may lead to more satisfactory results in the future. (Ill.). 3 cols.—*Engr.*, April 20th, 1900.

Danger Signals. *Sound-Signals to prevent Ships from colliding during Fogs.* By M. Charles Arnaud. Description of an apparatus, which the inventor calls "Odograph" (Route Indicator) for indicating by sound the position of a ship. 6 cols.—*Bull d.l. Soc. Scient. Industr. d. Marseille, First Quarter, 1899.*

Floating Dry Dock. *Huge Steel Floating Dock at the Yard of Blohm and Voss, Hamburg.* Short description of the largest floating dry dock yet constructed, having a capacity of 17,500 tons, only 500 tons less than the new United States floating dock for Algiers, La., now under construction at Sparrow's Point, Md., U.S.A. 1¼ col.—*Mar. Engrg.*, April, 1900.

—— *U.S. Floating Dry Dock at Algiers, La., U.S.A.* Description of the structural details and general features of this gigantic dry dock and the approaches to it. 4 cols. —*Marine Engrg.*, Feb., 1900.

Gasoline Yacht. *Gasoline Yacht "Lady Francis."* Description of a power-driven pleasure yacht with internal combustion engines, recently constructed for a Boston owner, having a length of 70ft., 11ft. beam, and 4ft. 2in. draft, with a gross tonnage of 30·16 tons. (Ill.). 1¼ col. —*Mar. Engrg.*, April, 1900.

Ice Breaker. *Details of Construction and Operation of Russian Ice Breaker Ermack.* Extracts from Notes on Naval Progress published by the United States Office on Naval Intelligence, dealing with the Russian Ice Breaker *Ermack*, accompanied by plans of the vessel, which is three times as powerful as any vessel of the kind previously constructed; it was designed by Vice-Admiral Marakoff, of the Russian Imperial Navy, and built last year in England by W. G. Armstrong, Whitworth and Co., for the Russian Government, her principal dimensions being: Length, 305 feet; beam, 71 feet; depth to upper deck, 42 feet 6 inches. (Ill.). 3 cols.—*Mar. Engrg.*, March, 1900.

Marine Congress.—*International Marine Congress at Paris.* Programme of the Congress to be held during the Exhibition of 1900. 2 cols.—*U. S. Consular Reports* Feb. 14th, 1900.

Marine Engines.—*Turning Moments of Marine Engines.* By Dr. Lorenz. Abstract of a paper read before the Institution of Marine Architects in which the author differs from the frequently expressed opinion that it is quite impossible to obtain a good uniformity of the turning moments in combination with a good balance of the reciprocating masses, and tries to demonstrate that the balance of the reciprocating masses not only agrees well with the conditions for the most uniform possible diagram of turning moments, but is absolutely necessary for obtaining a good uniformity of the angular velocity of the crank shaft. 3 cols.—*Engng.*, April 20th, 1900.

Propeller Shafts.—*Corrosion and Failure of Propeller Shafts.* By H. Scott Younger, Esq., B.Sc. Abstract of a paper read at the 41st Session of the Institution of Naval Architects, April 1900, dealing with the causes of the frequent fracture of tail-end shafts, many of which have resulted in disastrous loss of property and of life. (Ill.). 4½ cols.—*Mech. Engr.*, April 21st, 1900.

Sails of Ships.—*Combined Action of Steam and Wind.* By H. C. Vogt, M. Inst. Danish, C.E. The article has the object of showing in what enormous degree the efficiency of properly constructed sails is raised by means of an extra push or thrust in the ship. 5½ cols.—*Steamship*, April, 1900.

Ships.—*The Rolling of Ships on Waves.* Abstract of a paper on an Experimental Method of Ascertaining the Rolling of Ships on Waves presented to the Institution of Naval Architects by Captain G. Russo, describing, among other matters, a very ingenious machine constructed by the author and named "Navipendulum." 2½ cols.—*Engr.*, April 6th, 1900.

—— *The Rolling of Ships on Waves.* A paper by Captain G. Russo, Naval Architect, Royal Italian Navy, read before the Institution of Naval Architects, describing experiments for ascertaining the motion of rolling of ships on waves and an ingenious instrument devised by the author for that purpose. (Ill.). (To be continued). 5½ cols.—*Engng.*, April 6th, 1900.

Steamers.—*Disinfecting Steamer Sanator for the U.S. Marine Hospital Service.* By C. M. Green, Engineer. The article describes an interesting example of unusual marine construction, namely the disinfecting steamer Sanator, just completed by the Kennington Engine Works of Philadelphia, U.S.A., for the United States Marine Hospital Service. (Ill.). 8 cols.—*Mar. Engng.*, March, 1900.

Steam Yachts.—*American Builders of Steam Yachts.* The article describes the progress and rapid development of steam yacht building which at present extends to nearly all the principal ship yards in the United States. 3 cols.—*Marine Rev.*, Oct. 22nd, 1900.

Submarine Danger Signal.—*The Submarine Look-out (La Vigie Sous-Marine) System Orrechoni.* Description of a torpedo-shaped look-out, to be connected by cables with a ship and to move in advance of it at a distance of about 700 metres. The apparatus is propelled by electricity and automatically indicates by electric bells and signal card its collision with any obstacle in the route over which the ship is travelling. (Ill.). 7 cols.—*Bull. d.l. Soc. Scient. Industr. d. Marseille.*, First Quarter, 1899.

Tugs.—*New Steel Screw Transfer Tugs for the N.Y., N.H. & H. Railroad Co.* The article describes two large powerful steel screw tow boats for the New York, New Haven and Hartford Railroad Co., to be used as transfer tugs between Oak Point and Jersey City in New York Harbour, now under construction at the Bath Ironworks, Bath, Maine, U.S.A. (Ill.). 4½ cols.—*Mar. Engng.*, March, 1900.

Water Transport.—*The Water Transportation of Grain.* The article deals with the means of transporting grain in the United States from the harvest fields in the North-west to the seaboard, commenting on some new methods designed to effect a saving in cost as well as economy of time, that are just being introduced and have not yet had time to adjust themselves. (Ill.). 3½ cols. —*Sci. Am.*, April 14th, 1900.

MECHANICAL ENGINEERING.

1. Boilers, Furnaces and Fuel.

Bent-Tube Boilers.—*Practical Data Relating to the Building of Bent-Tube Boilers.* By John Platt, Ass. M. Am. Soc. Nav. Engrs. Description of the mechanical appliances necessary for the economical production of these boilers and the plan adopted in the laying out and building of them. A Thornycroft boiler of the "Daring" type was selected as example. 11 cols.—*Journ. Am. Soc. Nav. Engrs.*, Feb. 1900.

Blast Furnace Slag.—*Utilisation of Blast Furnace Slag.* The article, after describing the various uses formerly made of blast-furnace-slag speaks of the enthusiasm created some time ago by the announcement that cement could be made of it and the reaction that followed when it became known that the cement so made was of an unreliable quality and that slags only of a special kind were useful. It finally describes the invention recently made by Mr. Albrecht Stein of Wetzlar, Germany, who has succeeded in overcoming all the difficulties and in making a Portland cement of the very best quality from blast furnace slags. 2½ cols.—*Iron & Steel Trde. Journ.*, March 24th, 1900.

Blast Furnaces.—*Comparison of American and British Blast Furnace Practice.* By Mr. T. B. Rogerson. Abstract of a paper before the West of Scotland Iron and Steel Institute, beginning with the system adopted in a modern Scottish works and describing afterwards the English Blast-Furnace Practice and that of America. 4 cols.—*Iron & Steel Trade Rev.*, March 24th, 1900.

Boilers.—*The Efficiency of Steam Boilers and Surface Condensers.*—By T. E. Stanton, M. Sc. Abstract read before the Owens College Engineering Society, describing experiments made by the author fully confirming the theory outlined by Professor Osborn Reynolds (in a paper read before the Literary or Philosophical Society of Manchester in 1874) of the passage of heat from one fluid to another across an intervening plate of metal and the conditions under which this passage would be most rapid. 6 cols.—*Mech. Engr.*, March 31st, 1900.

Boiler Trials.—*Code of 1899. For Conducting Steam Boiler Trials.* Complete contents of the revised code for conducting steam-boiler trials adopted by the Am. Soc. of Mech. Engrs. with a few selections from the preamble and the appendices. 39 cols.—*Journ. Am. Soc. Mech. Engrs.*, Feb. 1900.

Exhaust Steam.—*Utilisation of Exhaust Steam.* Reprint from the *Manufacturer* dealing with the surprising results attained by Prof. E. Josse of the Royal Technical High School, at Charlottenburg, with the use of exhaust steam for the generation of power. 2½ cols.—*Electricity* (New York). April 11th, 1900.

Furnace Gases.—*Utilisation of Furnace Gases for the Driving of Gasmotors at the "Donnersmarkhütte" and "Friedenshütte."* By Chief Engineer Müller of the "Donnersmarkhütte" and Inspector Warnell of the "Friedenshütte," Silesia. The article is devoted to a report by these gentlemen on the working of gasmoters of the Otto-type fed by furnace gases. 10 cols.—*Stahl. u Eisen*, April 15th, 1900.

Furnaces.—*Ingot Heating Furnace.* Description of a continuous process to supersede the soaking pit, the casting being charged in a vertical position and pushed through automatically. The inventors are Samuel T. Wellman, of Cleveland, Fred. H. Daniels, of Worcester, Mass., and Charles H. Wellman, of Cleveland, O., U.S.A. (Ill.). 2 cols.—*Am. Mftrr.*, April 5th, 1900.

Gasmotors.—*The Increasing Use of Powerful Gasmotors in Modern Industries.* (Conclusion). (Ill.). 11 cols —*Stahl. u. Eisen.*, April 1st, 1900.

Liquid Fuel.—*The use of Liquid Fuel in Iron-Works in Russia.* The author of the article, Mr. J. Preiner, of Kapfenberg, Germany, describes the various methods of employing liquid fuel, such as coal oil, naphtha, &c., as fuel in furnaces in the various branches of the iron industry. 9 cols.—*Stahl. u. Eisen.*, April 15th, 1900.

Lubrication.—*Air as a Lubricant.* By Herman S. Heichert. Description of a method of using air as a lubricant in a journal bearing in a machine designed by Professor Albert Kingsbury of the Mechanical Department of the Worcester Polytechnic Institute. (Ill.). 1½ cols.—*Mech. Wrld.*, April 20th, 1900.

Mechanical Stoker.—*The "Koker" Mechanical Stoker.* Short description of the Mechanical Stoker of that name devised and constructed by Messrs. Meldrum, Brothers, Manchester, which, while retaining all the beneficial features of the coking system gives a much higher boiler duty and is well-known in the market. (Ill.). 1 col.—*Mech. Wrld.*, March 23rd, 1900.

2. Compressed Air.

3. Engines and Motors.

Automobiles.—*Automobiles up to date.* The writer of the article comes to the conclusion, that in the United States "Fake Stock Companies" have been capitalised at $650,000,000 and that motor vehicles never can compete with the horse and wagon. The electric vehicle, he says, is so far a success that the smaller kind can be run over city streets under favourable circumstances, the hacks or hansoms, weighing upwards of three thousand pounds, can carry 2 passengers each on an average of about fifteen miles without recharging the batteries, unless these fall on a shorter run. The hydro-carbon motors can make runs from 500 to 1000 miles in good time without going to pieces, providing a skilled machinist has them in charge, but leaving a most disagreeable odour; the steam-motors are miniature locomotives, leaving a train of steam, if not smoke, behind them, while the compressed air has thus far gone no further than to show its presence upon two massive trucks and a colossal failure financially. 4½ cols.—*Am. Mftrr.*, March 22nd, 1900.

—— *The Electric Automobile.* By A. L. Riker. Abstract of a paper read at the 20th Meeting of the New York Electrical Society, New York City, March 22nd, 1900, pointing out the advantages which this type of vehicle, in the author's opinion, possesses over all other forms of motor vehicles. 4½ cols.—*Electricity* (New York), April 18th, 1900.

—— *The De Dion Motor and its Antecedents.* The present article is intended to supplement a paper by Mr. J. D. Roots, previously published on "Petroleum Motor Vehicles," and deals with the De Dion Motor as an example of the present tendency for a high-speed air-cooled motor, describing its historical antecedents, beginning with the gunpowder engines devised by Huygins and Hautefeuille in 1678 wherein the explosive force of gunpowder was employed to propel a piston. 3½ cols.—*Autom. Journ.*, April 1900.

—— *The "Balmoral" Motor Char-a-Banc.* Description of an automobile with sitting room for 16 persons, provided with a two-cylinder horizontal pretroleum-spirit motor. ¾ col.—*Ind. & Iron*, Feb. 9th, 1900.

—— *An Electromobile Trolley System.* Description of a trolley-fed automobile system now being experimented with in France on a line somewhat over half-a-mile in length on a road along the Seine just outside the limits of Paris, invented by M. Lombard Gerin. 1½ cols.—*Autom. Journ.*, April 1900.

Engines.—*The Steam Engine at the End of the Nineteenth Century.* By Prof. R. H. Thurston. Abstract of a paper read before the American Society of Mechanical Engineers, in which the Author describes certain tests of a steam pumping engine of great efficiency, which was studied as a thermo-dynamic engine. (To be continued.) 5 cols. *Mech. Engr.*, April 7th, 1900.

Engines.—*The Steam Engine at the End of the Nineteenth Century.* By Prof. R. H. Thurston. Abstract of a paper read before the American Society of Mechanical Engineers. (Conclusion) 7 cols. *Mech. Engr.*, April 21st, 1900.

—— *The Engines of the Corvette "General Baquedano."* By Magnus Sandison. Abstract of a paper read at the 42nd session of the Institution of Naval Architects, April 5th, 1900, describing the machinery of a Chilian schoolship built by Sir W. G. Armstrong, Whitworth & Co., Ltd. The design of the propelling engines possesses some novel features, and the arrangement forms a combination which solves with a considerable measure of success, in a singular manner, and at one and the same time some important problems which have of recent years engaged the attention of those interested in the design and manufacture of the propelling machinery of ships. (Ill.) 1½ col.—*Engr.*, April 13th, 1900.

—— *The Engines of the Corvette "General Baquedano."* By Mr. Magnus Sandison. Abstract of a paper read before the Society of Naval Architects. Description of the engines constructed for this vessel of the Chilian navy by Messrs. Hawthorn, Leslie & Co., Ltd. 3¾ cols.—*Engrg.*, April 20th, 1900.

—— *300 H.P. Vertical Engines.* Description of engines of a triangular expansion type with overhead cylinders and double-cranked shafts, of 3,000 h.p. each, two of which have already been built for the Luisenstrasse Central Station of the Berlin "Elektrizitätswerke." By Sulzer Brothers, of Winterthur, and one of which is building. (Ill.) 3 cols.—*Mech. Wrld.*, March 30th, 1900.

—— *The Relative Advantage of Ordinary Compound Locomotives.* By Charles Ernest Wolff, B. Sc., Ass. M. Inst. C. E. The author makes a comparison between the various types of engines, beginning with a general consideration of Compound Locomotives. 6 cols.—*Mech. Engr.*, April 21st, 1900.

—— *American Freight Locomotives and the Engines of the "Oceanic."* Comparison between the power of one of the mammoth freight locomotives built in many of the locomotive works of the United States at present, and the gigantic engines of the Transatlantic steamer *Oceanic.* (Ill.) 1¾ cols.—*Sci. Am.*, March 31st, 1900.

—— *Electric Lighting Engines for the Paris Exposition.* Description of an engine built by S. Borsig, Berlin, which is a 2,500 h.p. engine, being one of a group of four, three of which are 2,500 h.p. engines, and the fourth a 1,500 h.p. engine. (Ill.) 1½ cols.—*Engr.*, (Cleveland U.S.A.) April 1st, 1900.

—— *How the Common Syringe Became a Steam Engine. A Tale of Mechanical Evolution.* By Robert L. Galloway. The author passes in review the various transformations of the steam engine from its earliest forms to the most modern types and leads its origin back to the syringe. (To be continued). 2¼ cols.—*Coll. Guard.*, April 20th, 1900.

—— *The Locomotive: Recent Practice and the Future.* By F. W. Dean. Extracts from a paper read before the New England Railroad Club. 3½ cols.—*Mech. Wrld.*, March 23rd, 1900.

—— *The Old and New Pumping Engines of Dry Dock No. 1, Brooklyn Navy Yard.* Description of the reconstructed pumping plant of Dry Dock No. 1, which is to be laid down shortly and gives striking evidence of the advance made during the past half century in the construction and operation of pumping machinery. (Ill.) 1½ col.—*Sci. Am.*, March 24th, 1900.

—— *Drop in Multiple Expansion Engines.* Editorial Comments on a paper by B. L. Weighton, read before the North East Coast Inst. of Engrs. and Shipbuilders. 2 cols.—*Engr.*, Jan. 26th, 1900.

—— *A Crankless Engine.* Description of an engine invented by Mr. Ljungström, a Swedish engineer, obviating many difficulties existing in previous rotary or semi-rotary engines, the essential feature being that it has balanced reciprocating elements adapted to react with an elliptical path to produce rotation. (Ill.) 4 cols.—*Mar. Engr.*, April 1st, 1900.

—— *Engine Tests V.* By George H. Barrus. The present instalment deals with the effect of superheating. The tables referred to, giving the result of 58 tests of simple and compound engines, were printed in the issue of April 7th. 4¾ cols.—*Engrg. Rcd.*, April 14th, 1900.

Engines.—*Six-Wheels-Coupled Express Passenger Engine on North Eastern Railway.* Description of one of the class of six-wheels-coupled express engines which were put into service on the North Eastern Railway last autumn, and were designed by Mr. Wilson Worsdale, M. Inst. C. E., to work the heavy express trains, some of which weigh 350 tons. (Ill.) ¾ col.—*Ry. Engr.*, April, 1900.

—— *New Valve Gear for Steam Engines.* Description of the special features of the Lang valve gear, which seems to be very successful, to judge from the reports on its effect upon marine and stationary engines to which it has been applied. 1¾ cols.—*Engrg. News*, Feb. 15th, 1900.

—— *The Behrend Zimmermann Cold Steam Engine.* In the Second Part of the Report of the Engine Laboratory of the Technical High School at Berlin, Prof. E. Josse, who is in charge of the laboratory, describes a series of experiments undertaken with the object of raising the thermal efficiency of steam engines and publishes the following result: In a compound engine with a condensation of about 40 horse-power, 56 per cent. of the indicated horse-power were added without the consumption of additional steam. The present article describes the method employed for obtaining this highly satisfactory result, which is of the utmost importance for the whole steam-power industry. 4 cols.—*Stahl. u Eisen*, April 15th, 1900.

—— *Steam Engines for Electric Traction.* By Prof. A. Jamieson, M. Inst. C. E., F.R.S.E. The author gives a concise answer to the questions: what are the special requirements of successful traction engines? wherein do they differ from electric, light, marine, cable, haulage, factory and other engines? what are the maximum and minimum size of units that should be employed? how should these units be arranged and worked? and finally, what are the leading principles which regulate the design of these engines and whereby can the r efficiency and economy as steam users be most effectually secured? (Ill.) 12 cols.—*Light Ry. & Tramw. Journ.*, April 1900.

—— *Gas and Oil Engines.* A series of articles dealing with the structural peculiarities, advantages and disadvantages of such engines, explaining their design and operation. (Ill.) 3 cols.—*Power*, Feb., 1900.

—— *On Balancing of Steam Engines.* By Herr Otto Schlick, Member. Read before the Institution of Naval Architects, in which the author discusses the method of finding the balance for a four-crank engine, the latter being the type that, according to him, offers the most practical interest. 4¾ cols.—*Engrg.*, April 20th, 1900.

—— *Gas Engine Progress.* By E. V. Kerr. Outlining the historical development of the gas engine from the gun-powder engine designed by the Dutch philosopher Hugghens, in 1860, to its most modern types, and comments on the future prospects of this form of engine. 9 cols.—*Mod. Machy.*, April, 1900.

—— *Electrical Ignition for Gas and Gasoline Engines.* The author describes a number of the most successful igniting devices in use at the present time, dividing them into two classes—the primary, and secondary igniters, the latter commonly called the "jump spark" igniters. 2½ cols.—*Elec. Wrld. & Engr.*, April 7th, 1900.

Motors.—*The Dawson Oil Motor.* Description of a motor designed with the object of overcoming the drawbacks attending the use of internal combustion machines, such as their inability either to start themselves or to reverse, their failure to exhaust completely, and their inflexibility of output. For this purpose the designer has provided a compressed air-system which is incorporated into the engine itself. (Ill.) 2¾ cols.—*Autom. Journ.*, April, 1900.

4. Power and Transmission.

Boring Machines.—*Special Boring Machine.* Description of a boring machine especially designed by the Newton Machine Tool Works, Philadelphia, U. S. A., driven by an independent motor attached to the end of the frame. (Ill.) 1 col.—*Machy.* (New York), April, 1900.

Pumps.—*Donkey Pumps.* By A. H. Burnand. The article deals with donkey pumps, of which the author states that they are usually, for their size, the hardest worked and least cared for engines in steam plants, particularly in marine work. 2 cols.—*Mech. Wrld.*, April 13th, 1900.

Steam Turbines.—*Westinghouse-Parsons Steam Turbine.* The article describes the installation and the working of steam turbines of the Parsons type, but of a considerably improved pattern, at the Westinghouse Air-brake Company, at Wilmerding, Pa., U. S. A., where they have been in operation for several months. (Ill). 4¼ cols.—*Am. Mfrr.*, April 12th, 1900.

5. Machine Works, Shop & Foundry.

Casting.—*The Casting of a Lathe Bed.* Reproduction of extracts from an article by R. H. Palmer, in *The Foundry*, describing the casting of a lathe bed 27 ft. long, involving some interesting principles in moulding. (Ill.) 1 col.—*Mech. Wrld.*, March 30th, 1900.

Crane Bed.—*A Portable Crane Bed.* By Joseph Horner. The article describes a type of bed which is very largely used for the lighter class of portable steam cranes, or those of about 3 tons power and under. (Ill.) 2 cols.—*Mech. Wrld.*, April 12th, 1900.

Foundry.—*A Hydraulic Cylinder Pattern.* By Joseph Henry. Account of a method by which the pattern for one of the lifting cylinders of a hydraulic crane can be made, offering a good example of the economy of pattern making in loam when the cylinder is large in diameter and of considerable length.—*Mech Wrld.*, April 17th, 1900.

Heavy Tools.—*Some Heavy Ship and Bridge Building Tools.* Article describing some types of tools built by Messrs. Craig and Donald, of Johnstone, near Glasgow, notably one of the heaviest types of combined punching and shearing machines; a set of heavy bending rolls arranged for belt power; a tool for punching manholes hydraulically; a powerful plate-edge planing machine; a heavy multiple punching machine; and a type of three radial arm-drilling machine (Ill.). 2 cols.—*Mech. Engr.*, April 21st, 1900.

Machine Tools.—*American Machine Tools.* Description of a milling machine built by the Great Machine Tool Company, of Cleveland, O., U.S.A., designed especially for sewing machine, tpyewriter, gun and bicycle work, and suitable for milling work 16in. long. It is said to be quick-acting and light. (Ill.) 2¾ cols.—*Engr.*, April 20th, 1900.

Pipe Threading Machine.—*The Forbes' Patent Die Stock.* Description of a machine for the cutting and threading of wrought-iron pipes, manufactured after the Forbes' patent by Messrs. Curtis and Curtis, of Bridgeport, Conn., U.S.A., which has the advantage of being portable, and of permitting to thread pipes up to 12in. (Ill.). ¾ col.—*Engng. and Min. Journ.*, April 7th, 1900.

Pneumatic Tools. — *Portable Pneumatic Tools.* Description of the details of the "Little Giant" hammer, hand riveters, yoke riveters, portable drills, air hoists, pneumatic chair hoists, pneumatic jacks, pneumatic shears and lining drills. 3, 1¾ and 5 cols. respectively. —*Mech. Wrld.*, March 23rd, 30th, and April 6th, 1900.

Tools.—*The Toolroom. For the Manufacturer and the Engineer.* By Walter Heap. Extracts from a paper read before the Manchester Association of Engineers, describing the suitable equipment in a manufacturer's premises, where repetition work greatly prevails, and in an engineer's establishment, which requires less costly tools. (To be continued.) 2 cols.—*Mech. Wrld.*, April 6th, 1900.

6. Refrigeration and Cold Storage.

Cold Storage.—*Ice Making and Cold Storage in the North of Scotland.* The first of a series of articles on the refrigerating industry in Scotland, describing the Dundee Ice and Cold Storage Co.'s plant, which is nearing completion. 4¼ cols.—*Ice and Cld. Strge.*, April, 1900.

Refrigeration.—*A British Ice Making Plant in Holland.* Description of an imported installation of ice-making machinery, recently completed and now in full work at Yminden, a fishing port on the North Sea coast of Holland, near Amsterdam. (Ill.). 4 cols.—*Ice and Cld. Strge.*, March, 1900.

—— *Compania Sausinena de Carnes Congeladas, Frozen Meat Stores,* Newcastle-on-Tyne. Description of the frozen meat stores into which the Spanish Company above-named have converted the fish market of Newcastle-on-Tyne. (Ill.). 3½ cols.—*Ice and Cld. Strge.*, February, 1900.

Refrigeration.—*Refrigeration and Cold Storage in Italy.* Description of the Taranto Ice Factory, which was the first ice factory started in the Italian province of Apulia, in 1898, where, until then, snow had been the only means employed for cooling.—*Ice and Cld. Strge.*, April, 1900.

—— *Refrigerating Machinery.* By M. Sibenaler, Professor of Applied Mechanics at Louvain University. This contribution gives a full theoretical consideration of the principles underlying the action of refrigerating machinery. 7 cols. and 5¼ cols. respectively.—*Ice and Cld. Strge.*, February and March, 1900.

—— *Refrigeration and Insulation.* Abstract of a paper read by Mr. F. Seaton Snowdon before the meeting of the Shipmasters Society, on Thursday, March 22nd 1900. 6 cols.—*Ice and Cld. Strge.*, April, 1900.

—— *Sulphurous and Refrigerating Machine.* Description of refrigeration machinery used in various continental towns; the present instalment deals with the plants of the Quiri-Rau Co., at Strassburg. The Municipal Cold Stores, F. Schaal's French Chocolate Co., Schneider's Brewery, Prieur's Brewery, Maisenbacher, Butcher, Messrs. Haehl and Co., Chemical Works, all of Strassburg, use Quiri-Rau machinery, and so do the Welsback Dairy Factory, Belgium, and Baron Peers of Oestchamp, Belgium. (Ill.). 8 cols.—*Ice and Cld. Strge.*, February, 1900.

—— *The Hagerup-Doughty Ice Factory, Grimsby.* The article deals with a fine factory under management of the Hagerup-Doughty Ice Factory and Cold Storage Company, Ltd., the only factory, so far, in the important fishing trade station of Grimsby. Another factory is now in course of construction. 3¼ cols.—*Ice and Cld. Strge.*, March, 1900.

—— *The Growth of Artificial Refrigeration in Munich during the Last Quarter of a Century.* By Professor Dr. Carl Linde. Extracts translated from the Report of the Seventy-first Meeting of German Scientists and Physicians, published in the *Zeitschrift für die Gesammte Kälte-Industrie*, 3¼ cols.—*Ice and Cld. Strge.*, February 1900.

—— *The Leyland Liner "Georgian."* Description of the refrigerating plant for working two cold chambers of an aggregate capacity of 40,000 cubic feet on a ship for carrying beef between Boston and Liverpool. 2 cols. *Ice and Cld. Strge.*, April, 1900.

—— *Mechanical Refrigeration. IV.* By Otto Luhr. (Continuation.) 3¼ cols.—*Power*, April 1900.

7. Miscellaneous.

Fans.—*Fan Volume Recorder.* Translated extracts from a communication entitled "Appareil Engregistreur du Volume d'air débité par les Ventilateures," by M. Murgue, General Manager of the Montalembert Colliery to the Sainte Etienne Section of the "Société de l' Industrie Minerale." (Ill.). 3¼ cols.—*Coll. Guard*, April 12th, 1900.

Perspective Drawing.—*Apparatus for Making Perspective Drawings.* Description of a very ingenious but very simple instrument for producing an accurate perspective view of any object from the plan and the elevations, invented by Professor von Ziegler, of Geneva. (Ill.). ¾ col.—*Sci. Am.*, April 14th, 1900.

Indexing.—*A Decimal Index to Mechanical Engineering Literature.* Description of the very ingenious and practical system of indexing used in the Department of Mechanical Engineers in the University of Illinois. 13 cols.—*Engng. Rcd.*, February 17th, 1900.

MINING AND METALLURGY.

1. Coal and Coke.

Coal.—*Coal Analysis.* Review of the final report of the Committee of the American Chemical Society on Coal Analysis, containing a full account of all their recommendations, which differ from the usual practice. 3¼ cols.—*Engng. Rcd.*, February 10th, 1900.

Coal Handling.—*Coal Handling Plant at the Wandsworth Electric Lighting Station.* Description of a plant chosen by Mr. A. J. Lawson, of Artillery Mansions, S.W.,

when designing the station, and executed by Messrs. Graham, Morton and Co., Ltd., of the Black Bull Str. Works, Leeds. (Ill.). 1¼ col.—*Engng.*, April 20th, 1900.

Coaling Station.—*The United States Foreign Coaling Stations.* Digest of the recent report of Admiral Bradford of the U.S. Navy, dwelling on the great importance of the coaling trade and coal stations for a naval power. 1¼col.—*Iron and Coal Trds. Rev.*, February 2nd, 1900.

Coal.—*Coal in Russia.* Summary of the Report of the Coal Crisis in Russia, and the main sources of the native supply, by Mr. H. Cooke, British Commercial Agent in Russia, received at the Foreign Office March 5th, 1900. 2½ cols.—*Iron and Steel Trde. Journ.*, March 24th, 1900.

—— *Coal in the Pacific North-West.* The article deals with the fuel supply of the rapidly developing West coast country of the United States, and draws attention to the lack of railway facilities, concluding with comments on the coke production. 5 cols.—*Mftrr.*, March, 1900.

Coal Mining.—*The Coal Resources of the Transvaal.* The article describes the valuable coal deposits in that country, which is sufficient to place it in the front rank of those that produce cheap and good coal over a large area, giving statistics and diagrams showing the character of the deposits. 3 cols.—*Iron and Coal Trds. Rev.*, April 13th, 1900.

—— *Colliery Surface Arrangements.* By Mr. S. A. Everett. This is the Lewis Prize Essay, South Wales Institute of Engineers, and describes fully the best practical arrangements for the delivery of coal from pit cage in railway waggons for a gross quantity of, say, 1,500 tons per day, exclusive of coal washing and coking. (Ill.). 8½ cols. *Iron and Coal Trds. Rev.*, April 6th, 1900.

Coking.—*Coke-Oven By-products and their Chemistry.* By J. D. Pennock. This paper which was presented some time ago to the American Chemical Society, is one of the most complete publications on the chemistry of the coke-oven by-products. (To be continued.) 3 cols.—*Iron and Coal Trds. Rev.*, April 6th, 1900.

—— *Corrections about Keneval Process.* The inventor of the process gives some data regarding the output of his ovens. These ovens are situated at Knoxville, Tennessee, U.S.A., and the plant consists of a battery of three, in which each of the most varied kind has been coked. 1 col.—*Am. Mftrr.*, April 5th, 1900.

Hauling Machinery.—*Methods of Emptying Coal Boats.* By Jenner G. Marshall, A.M., Inst. E.C. Abstract of a paper read before the Birmingham Association of Mechanical Engineers, describing a few methods of hauling coal, taking it from the vessel in which it has arrived from the colliery and depositing it at some distance from the boat. (Ill.) 7½ cols.—*Mech. Engr.*, April 14th, 1900.

2. Copper.

Copper.—*Copper from the Ore to the Wire Bar.* By Albert R. Ledoux. The author describes the various steps through which copper passes after leaving the mines, until it comes into the hands of the electrical engineer. 7½ cols.—*Elec. Rev.* (New York)., April 11th, 1900.

Copper Mines.—*The Union Copper Mines, Gold Hill, North Carolina, U.S.A.* By Dr. A. R. Ledoux. Description of this mine originally worked for gold but long ago abandoned and only recently reopened for copper mining, together with an outline of its fine plant. The ores are stated to carry small quantities of gold and silver with the copper. 3¾ cols.—*Engrg. and Min. Journ.*, February 10th, 1900.

3. Gold, Silver and Diamonds.

Gold Mining.—*Beach Sands of the Pacific Coast.* By W. J. Adams, E.M. Description of placer-mining in the gold-bearing sands on the Pacific coast, extending from the Bay of Monterey northward practically all along the American Continent. (Ill.). 12 cols.—*Mod. Mach'y.*, April, 1900.

—— *The Gold Zone of Copalquin, Durango, Mexico.* By Frank B. Fowler. Account of San Fernando Mines and their produce. (To be continued.) 2¾ cols.—*Engrg. and Min. Journ.*, February 24th, 1900.

4. Iron and Steel.

Iron and Steel.—*The Metallurgy of Iron and Steel.* By Prof. A. Humboldt Sexton, F.I.C., F.C.S., etc. (Continuation.) The present instalment describes "double melting," or Walloon process, notably the South Wales Process, and the Lancashire Process. 3 cols.—*Mech. Engr.*, March 24th, 1900.

Cast Iron.—*The Chemistry and Physics of Cast Iron. Briefly considered.* By J. E. Johnson, jun. The author gives us the reason for writing on the subject that he has been both a furnaceman and a consumer of pig-iron, and thus has experience of a double kind, aiding him to give practical information. 5¼ cols.—*Am. Mach.*, April 5th, 1900.

Iron and Steel.—*The Metallurgy of Iron and Steel* By Prof. A. Humboldt Sexton, F.I.C., F.C.S., etc. (Continuation). The present instalment deals with the direct production of malleable iron, describing the Catalan Forge, American Bloomeries, the High Bloomery, Modern Process, the Husgafvel Process, the Siemens Direct Process, Sponge Process, etc. (Ill.). 4½ cols.—*Mech. Engr.*, April 7th, 1900.

Iron Industry.—*The Relations of Aluminium and Iron.* By Godfrey Molland. The author endeavours to show the fallacy of the alleged beneficial effects of aluminium when combined with iron and steel, and to reduce its value to absolute facts. He deals with the subject first under the heading of alloys, and then analyses the effects of aluminium upon malleable and cast-iron. 2¾ cols.—*Mech. Wrld.*, April 27th, 1900.

Nickel Steel.—*The Properties and Possible Uses of Nickel Steel.* Editorial comments on a paper by David H. Browne, read at the Institute of Mining Engineers. The editor dwells on the scarcity of nickel and the poor prospects of its increase unless a mine of nickel ore should be discovered. 5½ cols.—*Engng. News*, Feb. 16th, 1900.

—— *Nickel Steel and its value as an Alloy.* By David H. Browne. (Continuation.) This is a synopsis of experiment and opinion given at the American Institute of Mining Engineers. (To be concluded.) 2 cols.—*Am. Mftur.*, March 22nd, 1900.

—— *Nickel Steel ; its value as an Alloy.* By David H. Browne (Construction). The article is a synopsis of experiment and opinion, given at the American Institute of Mining Engineers. (Ill.) 1½ col.—*Am. Mftur.*, April 15th, 1900.

Pig Iron.—*Pig Iron Breakers.* By T. E. G. Morley and Enoch James. Abstract of two papers read before the West of Scotland Iron and Steel Institute, March 16th, 1900. The first of the two authors describes a machine, invented by him and used at the Whitehaven Hæmatite Iron and Steel Co., Ltd., and the other, Mr. James, gives an outline of a machine devised by him for the operation with hydraulic power, and working at Dowlais, Wales. The two machines appear to be the only of their kind. (Ill.) 3 cols. *Coll. Guard*, April.

—— *Notes on Pig Iron Breaker.* By Mr. T. E. G. Morley. Digest of a paper read before the Scotch Iron and Steel Institute, describing a method of pig iron breaking by mechanical means, with special reference to a machine patented by the author. The same subject is discussed by Mr. Enoch James, who also has devised a machine for this purpose. 3½ cols.—*Iron and Steel Trades' Journal* April 21st, 1900.

5. Mining.

Asbestos Mines.—*The Asbestos Mines at Thet'ord, Canada.* By L. P. Gratacap. Description of the working and the output of these mines, which supply the bulk of the asbestos consumed all over the world, and are situated in the Province of Quebec. (Ill.) 2 cols.— *Sci. Am.*, April 7th, 1900.

Mining.—*Methods of Priming and Firing Mine Shots.* Digest of a communication by Victor Watteyne and Lucien Denoëly, giving a description of a variety of methods, but drawing the conclusion that electric firing is the most suitable method. 1¼ col.—*Coll. Guard*, Jan. 26th, 1900.

—— *The Simmer and Jack Mines in the Transvaal.* Summary description of one of the oldest and most profitable mines of the Witwater mines, the plant of

which is one of the largest in the Transvaal, and which has been an extraordinary producer and dividend payer. (Ill.) 1½ col.—*Engng. and Min. Journ.*, April 7th, 1900.

Mining.—*The Mineral Production of India.* Summary of a report recently issued by the Department of Revenue and Agriculture of the Government of India, giving statistics of the mineral production of India in the five years 1894 to 1898. 1 col.—*Coll. Guard*, April 6th, 1900.

—— *A New Method of Shaft-Sinking.* By G. C. McFarlane. The author describes a method devised by him for sinking a shaft where it is necessary to pass through a bed of water-bearing strata, which he successfully tried in sinking a coal shaft through beds of gravel and sandstone, which caused a flow of 200 to 300 gallons of water per minute. (Ill.) 1 col.—*Engng. and Min. Journ.*, April 7th, 1900.

6. Miscellaneous.

Alabaster.—*Italian Ornamental Alabasters.* Extracts translated from Prof. Comm. Luigi Bombicci's report on the famous quarries of onyx, alabastrite and ornamental marbles, situated in Castelnuovo dell'Abbate Amiata, Province of Siena, Tuscany; recently reopened by the firm of Miller & Co., Leghorn, after a lapse of centuries. 2¼ cols.—*Bldrs'. Journ. and Arch. Rcd.*, April 18th, 1900.

Geology. — *The Dislocation of the Earth's Crust.* Abridged translation from the French of a work by M. E. Margerie and Dr. Heim, being an essay towards a classification of the dislocation of the earth's crust, which are of considerable interest to mining engineers. (To be continued.) 4 cols.—*Austr. Min. Stand.*, March 8th, 1900.

—— *The Dislocation of the Earth's Crust.* (Continuation.) Extracts from a French work by M. E. Margerie and Dr. A. Heim, on the subject, translated by G. Heimbrod. (Ill.) 4¾ cols.—*Austr. Min. Standard*, March 15th, 1900.

Magnesite.—*The Uses and Production of Magnesite.* The article deals with the use of Magnesite in the steel industry for lining furnaces and converters, in the manufacture of carbonic gas, epsom and glauber salts, as a filling for wall paper and as a fire proofing material. 2½ cols.—*Chem. Trd. Journ.*, April, 1900.

Nitric Acid Process.—*Lyte & Lunge's Nitric Acid Process.* Description of a process devised by Mr. Maxwell Lyte and Prof. George Lunge, which consists in heating together nitrate of soda and oxide of iron in a current of steam and air. The nitric acid is thus driven off as nitrous oxides, which, by contact with water can be converted into nitric acid, while left behind is a compound called ferrite of soda, which, when treated with boiling water, yields a solution of caustic soda and leaves undissolved the oxide of iron, which can be used over again. 3 cols.—*Engng. and Min. Journ.*, April 7th, 1900.

Rock Cutting.—*The Dwight Petrotome.* Account of a rock-slicing instrument, devised by Prof. Wm. B. Dwight, of Poughkeepsie, N.Y., and made by the C. H. Caudrey Machine Works, at Titchbury, Mass. This machine is of a class very useful to geologists, lapidaries, and all artificers of valuable minerals in small slabs or slips, since it permits the use and control of large, thin caps or discs of 8 to 12 in. in diameter, not thicker than ordinary 1 in. plate. (Ill.) 1 col.—*Engng. and Min. Journ.*, April 7th, 1900.

MUNICIPAL ENGINEERING.

1. Gas Supply.

Coal Gas.—*The Carbonisation of Coal for the Production of Illuminating Gas.* By Mr. W. R. Herring. Abstract of a paper read on the above subject before the Royal Scottish Society of Art by the author, who is the chief engineer and manager to the Edinburgh and Leith Gas Commissioners. 4¾ cols.—*Gas World*, March 31st, 1900.

Gas.—*Examination of Naphthalene in Coal Gas.* A paper by Dr. Colman and Mr. J. F. Smith, presented to the meeting of the Nottingham Section of the Society of Chemical Industry, describing a method for accurately estimating the quantity of naphthalene present in coal gas. 2¾ cols. *Journ. of Gas Lighting*, March 27th, 1900.

Coal Gas.—*Estimation of Naphthalene in Coal Gas.* By Dr. H. G. Colman and Mr. J. F. Smith. Reproduction in full of a paper read at the meeting of the Nottingham Section of the Society of Chemical Industry, and dealing with the important subject of the exact estimation of the quantity of naphthalene present in coal gas 3½ cols.—*Gas World*, March 31st, 1900.

Gas Engineering.—*Inaugural Address of Mr. Henry O'Connor*, before the Society of Engineers. Review of the progress and development in gas engineering during recent years. 8 cols.—*Journ. Gas Light*, Feb. 6th, 1900.

Water Gas.—*Carburetted Water Gas.* Description of the various peculiarities of a plant for the production of carburetted water gas, according to the system of Dr. Strache. (Ill.) 4¼ cols.—*Le Gaz*, April 15th, 1900.

—— *The Delhwick-Fleischer Water-Gas Process.* Reprint from *Engineering*, describing a process for the manufacture of water-gas by which it is said a utilisation of the fuel is obtained, fully equal to that obtained by the Siemens or Dawson processes. (Ill.) 3¾ cols.—*Engng. News*, April 12th, 1900.

2. Sewerage.

Sewerage.—*Sewerage Filtration through Coal.* Summary of experiments made at Sheffield and Wolverhampton, instructive as regards the value of coal for treating the effluents of chemical and septic tanks. 2¾ cols.—*Engng. Rcd.*, Feb. 3rd, 1900.

—— *The Sewerage of Frankfort-on-the-Main.* By James H. Fuertos, M.Am.Soc.C.E. The article gives a summary description of the main features of the sewerage plant of the city, of which the original system was designed by Mr. W. Lindley in 1863, and the additional improvements and extensions were carried out by his son in 1878. (Ill.) 1¾ col.—*Engng. Rcd.*, April 14th, 1900.

—— *The Operation of the Sewage Filter-Beds at Brockton, Mass., U.S.A., in 1899.* Summary of the annual report of Mr. Chas. R. Felton, City Engineer, of Brockton, embodying a condensed statement of the operations of the beds by Mr. Geo. E. Boiling, Chemist-in-charge, giving the result obtained by each bed as they were determined by means of systematic analysis. The information so obtained has been of great value in regulating the closing, raking and overturning of the material. 2¼ cols.—*Engng. News*, March 29th, 1900.

Subway and Sewers.—*History of the Pennsylvania Avenue Subway, Philadelphia (U.S.A.), and Sewer Construction connected therewith.* A paper presented by Messrs. George S. Webster and Samuel Tobias Wagner, Members Am. Soc. C.E. 28½ cols.—*Proc. Am. Soc. C.E.*, Feb., 1900.

3. Streets and Pavements.

Asphalt for Reservoir Linings.—*The Action of Water on Asphalts.* By George C. Whipple and D. Jackson. The article describes the tests undertaken for the purpose of determining the relative action of water upon some of the most important asphalts on the market, with reference to their use for reservoir lining. 5¾ cols.—*Engng. News*, March 22nd, 1900.

Pavements.—*Smoothness of Pavements.* By Daniel B. Luten, Instructor in Civil Engineering, Purden University. During the summer and autumn of 1899 about 35,000 square yards of street asphalt and about 5,000 square yards of asphalt block pavements were laid in the city of Lafayette, Ind., U.S.A. The new pavements, together with the existing pavements, together with the existing brick-pavements, new and old, and cedar block in poor condition afforded the author an opportunity to make a comparison to determine their relative smoothness. He has embodied the results of these tests in the present article. 6 cols.—*Engng. Rcd.*, March 31st, 1900.

—— *Some Theories regarding Cement Walks.* By Daniel B. Luten, Instructor in Civil Engineering, Purden University, U.S.A. The writer points out that cement walks are subjected to three kinds of forces, the imposed loads (including the weight of the walk itself, the upheaving effect of frost in the foundation, and the expansion and contraction) due to changes of temperature, and discusses the faults of construction of such walks with reference

to these requirements, suggesting modifications adapted to the circumstances. (Ill.) 5 cols.—*Engng. Rcd.*, April 14th, 1900.

Pavements.—*The Paving of Carriage Ways.* By A Surveyor. (Continuation.) The present instalment deals with what the author calls the ideal material for paving carriageways—asphalt. 3 cols.—*Bldrs. Jour. and Arch. Rcd.*, April 18th, 1900.

Roads.—*Road Construction in New Jersey, U.S.A.* Digest of the sixth annual report of Mr. Henry I. Budd, Commissioner of Public Roads, of New Jersey, containing an interesting acount of the road work which has been done in that State during the year ending October 31st, 1899. 5½ cols.—*Engng. Rcd.*, March 24th, 1900.

Subways.—*Subways for Street Pipes and Wires.* The article deals with the obvious advantages of subways for the purpose mentioned, though there is the drawback of the large first cost and the opposition of the many great corporations occupying the streets. Amongst the excellent examples of subways on the Continent are mentioned those of Milan and of Paris. (Ill.) 3½ cols.—*Engng. News*, March 15th, 1900.

Retaining Wall.—*Retaining Wall of Concrete with Metal Skeleton.* Translation from *Le Génie Civil.* Description of the construction of a temporary street below the general level in connection with the Paris Exhibition, in which the Hennebique system of combined concrete and steel was employed. ¾ col.—*Engng News*, Feb. 15th, 1900.

Tunnels.—*Municipal Tunnel Driving by Day Labour, Chicago.* By Paul G. Browne. The author shows by what method the city of Chicago succeeded completing, at much less than contract price, tunnelling work that had been abandoned by the contractors. (Ill.) 2¾ cols. —*Engng. Rcd.*, Feb. 3rd, 1900.

4. Water Supply.

Filtration Plant.—*Filtration Plant for the Albany Water Supply.* The city of Albany, N.Y., U.S.A., originally obtained its water supply to a certain extent from the Hudson River, where at low-water stages the sewage of the city as well as that of Troy, Schenectady, Utica, Rome and other towns, polluted the water supply. The death rate, naturally, was excessive. In 1896 the President of the Water Board, Mr. George I. Bailey, C.E., and Mr. Allan Hazen, C.E., recommended the abandoning the present intake and the establishment of a reservoir two miles further up the river. This work has been carried through, and is described in this article. (Ill.) 2½ cols.—*Sci. Am.*, March 24th, 1900.

Flow of Water.—*On the Flow of Water over Dams.* A paper presented by Mr. George W. Rafter, M. Am. Soc. C. E. The author points out that during the last 25 years 95 per cent. of all computations of flow of water over dams have been based upon the late Mr. James B. Francis's formula for the flow of water over sharp-crested weirs, although the author of the classical experiments with reference to sharp-crested weirs draws attention to the considerable variations in flow resulting from change of crest. The aim of Mr. Rafter's paper is to induce engineers to stop this irrational practice. 94 cols.—*Proc. Am. Soc. C.E.*, March, 1900.

Water Distilling.—*Water Distilling Plant at the Dry Tortugas.* Description of the equipment and the working of a large multiple effect distilling plant erected at Fort Jefferson, on the Dry Tortugas, Fla., to furnish water for the naval station and barracks at that place, and such vessels of the navy that may require fresh water. The plant has a guaranteed capacity of 60,000 gallons of distilled water in 24 hours, and has been tested to an output of 50 per cent. in excess of this. 8 cols.—*Engng. News*, March 29th, 1900.

Water Purification.—*Experimental Water Purification Plant at Philadelphia, Pa., U.S.A.* Describing a plant recently contracted for, which will be located close to the Spring Garden Pumping Station, on the Schuykill River, Philadelphia, for the purpose of investigating the action of the Schuykill River water upon a slow sand filter and also to test the various sands to ascertain the best for the object. ½ col.—*Engng. News*, March 29th, 1900.

Water Supply.—*Domestic Water Supply.* By J. M. Moss, M.A., M.I.C.E.I. A paper read before the Architectural Association of Ireland on March 20th, 1900, dealing with the means of securing an abundant supply, by using rain-water, wells, gravitation supply, pumps, the relative cost of hand and mechanical power, windmills, etc. 7½ cols.—*Bldrs'. Journ. and Arch. Rcd.*, April 25th, 1900.

Pavements.—*Filtration Plant of the Albany Water Supply.* The water supply of the city of Albany, N.Y., U.S.A., was originally obtained by gravity from certain reservoirs, and augmented later by taking water from the Hudson River. This latter supply of late years became polluted near the inlet by refuse from the city itself and neighbouring towns, and a report drawn up by Mr. George I. Bailey, C.E., and Mr. Allan Hazen, recommended the abandoning of the present inlet and the establishment of a new one about two miles further up the river. This important work has been carried through and is described in the present article. (Ill.) 3 cols.—*Contract Journ.*, April 25th, 1900.

Waterworks.—*Florence, Col., Waterworks.* By R. P. Garrett. The author describes the construction of these waterworks, in which the distinguishing features are a submerged dam for the purpose of forcing groundwater to the surface, and a gravity main about seven miles in length of vitrified clay pipe. 2½ cols.—*Engng. Rcd.*, Feb. 10th, 1900.

—— *Outlet Valves, Burralor Reservoir, Plymouth, England.* Description of 3-beat cage valves at the outlets of pipes 25 to 26-ins. in diameter, by which a gate chamber was rendered unnecessary. ¾ col.—*Engng. Rcd.*, Feb. 10th, 1900.

—— *The Mount Royal Pumping Station, Baltimore, O., U.S.A.* Full description of a recently completed Pumping Station, which is one of the finest and best equipped in the United States, having been designed to contain an ultimate pumping capacity of 52,500,000 per day, in three units of 17,500,000 gallon capacity each. 4¾ cols.—*Engng. Rcd.*, March 24th, 1900.

—— *Mr. Freeman's Report on the New York Water Supply.* An effort being made last year to commit the city of New York to a contract for a long term of years with a private water company, Comptroller Bird S. Coles engaged Mr. John R. Freeman, M.Am. Soc. C.E., to make a careful study of the present sources, the merits and demerits of the Ramapo project, the amount of waste and its prevention and the value of the present supply for fire protection. The results of this investigation are embodied in a series of articles of which this is the first. 6 cols.—*Engng. Rcd.*, April 14th, 1900.

—— *Sydney Water Supply.* Description of the water supply of Sydney, New South Wales, which combines successfully the useful with the ornamental in the new covered reservoir, at Centennial Park, which is almost the largest covered reservoir in existence. (Ill.) ½ col. —*Publ. Health Engr.*, April 7th, 1900.

5. Miscellaneous.

Garbage Reduction.—*The Barren Island Garbage Reduction Works, Greater New York.* Description of the methods employed for disposing of the garbage of Greater New York, and of the plants erected for that purpose on Barren Island, commented upon also in an editorial in the same issue. 10½ cols.—*Engng. News*, Feb. 1st, 1900.

Refuse Destructors. — *The Horsefall Destructors.* Description of a system of refuse destruction and its utilisation for steam purposes and treating in three English plants, embodying a report by Lord Kelvin and Mr. Archibald Barr. 2¾ cols.—*Am. Mfrr.*, April 5th, 1900.

—— *The Modified Horsefall Crematory.* Description of a refuse-destructor, especially suitable for the cremation of very wet city refuse, such as swill, night soil, sewage sludge, &c. 1¼ cols.—*Engng. Rcd.*, Feb. 3rd, 1900.

Sanitary Precautions.—*Sanitary Methods During the Bubonic Plague in Honolulu.* The article deals with the sanitary measures inaugurated by the Board of Health, especially in the Chinese quarters. 1¾ cols. *Engng. Rcd.*, Feb. 17th, 1900.

NAVAL AND MILITARY ENGINEERING.

Armour Plate Making.—*An Armour Plate Planing, Milling and Boring Machine.* Description of a milling and boring machine designed, built and in use in the works of the Russian Locomotive and Machine Works at Charkow, South Russia. 1 col.—*Am. Machs*, April 5th, 1900.

Armour Plates.—*Some Notes on the Development of Armour for Naval Purposes.* The article deals with the history of armour plating from the time that wrought-iron alone was used, *i.e.*, up to 1876 to the most recent development, describing the methods of plating armour, Harvey armour, compound armour, nickel steel plates, the cost of armour, &c. 3½ cols.—*Iron and Coal Trds. Rev.*, April 13th, 1900.

Battleships.—*Contract Trial of the United States Battleship "Kentucky."* By Commander Harrie Webster, U.S. Navy. Full description of the trial of this American twin screw, armoured, seagoing battleship, having a length of 368 ft. between perpendiculars, 72 ft. 2½ in. beam, and of 11,600 tons displacement at a load draught of 23 ft. 7⅜ in., constructed by the Newport News Shipbuilding and Dry Dock Company, Newport News, Va., Jan. 2nd, 1896. The mean speed for the two runs was 16·897 knots per hour with a horse-power developed by the main engines of 12,081·90. 24 cols.—*Journ. Am. Soc. Nav. Engrs.*, Feb., 1900.

—— *The New French Battleship "Suffren" and her Predecessor.* Description of a first-class French battleship named after the "Bailiff de Suffren," one of the most dangerous enemies the English fleets ever met. This battleship was launched at Brest on July 25th last, superseding a predecessor of the same name built in 1870. The new vessel described in this article is nearly twice as big as the old ship and will, when completed, displace 12,728 tons. (Ill.) 2 cols.—*Sci. Am.*, March 24th, 1900.

—— *On the Launch of a British Battleship from a Government Dockyard.* A paper read before the Inst., of Mech. Engrs., England, by H. R. Champness, Chief Constructor, R.N. Description of the launch of Devonport's first modern battleship, H.M.S. *Ocean.* (Ill.) 13¾ cols.—*Mar. Engng.*, April 1900.

Distilling Plant.—*Report of a Six-Day Trial of the "Lillie" Multiple-Effect Distillery Plant at Dry Tortugas, Jan. 12 to 29, 1900.* By Lieutenant R. K. Crank, U.S.N. Description of the tests of a distilling plant built after designs by S. Morris Lillie, Pres. of the Sugar Apparatus Manufacturing Company, Philadelphia, U.S.A. 14 cols. *Journ. Am. Soc. Nav. Engrs.*, Feb., 1900.

Electrical Application.—*The Electrical Equipment of Ships of War.* By C. E. Grove, M. Inst. Elec. Engs. The bulk of the paper deals with what has already been accomplished in this important matter in the British and other navies, but regard is also taken to point out certain imminent developments. (Ill.) 5½ cols.—*Elec. Engr.*, April 6th. (Continuation.) 8½ cols., April 13th, and 9 cols., April 20th, 1900.

Electrical Equipment.—*Electrical Equipment of Ships of War.* By C. E. Grove. (Continuation.) 10 cols.—*Elec. Engr.*, April 20th, 1900.

—— *The Electrical Equipment of Ships of War.* Abstract of a paper by Mr. C. E. Grove read at the Institution of Electrical Engineers, April 5th, 1900. (Continuation.) The present instalment deals with the maintenance of communication between the several departments, the gun and torpedo work, range finders and engine room communication. 3½ cols.—*Elec. Rev.* (London), April 20th, 1900.

Field Artillery.—*Modern Field Artillery.* (Continuation.) The present instalment deals with the 4·7-in. Breech-Loading Field Equipment, and concludes the series of the Field Artillery of Messrs. Vickers, Sons and Maxim. 1¾ col.—*Engng.*, April 26th, 1900.

Guns.—*Modern Field Artillery.* (Continuation.) Description of a 12-pounder gun and equipment constructed by Messrs. Vickers, Sons and Maxim, Ltd., known as the "separable" gun, from the fact that the gun as well as the carriage can be taken to pieces. (Ill.). 3 cols.—*Engng.*, April 6th, 1900.

Guns.—*The Colt Automatic Gun.* Description of a Colt Automatic Gun, weighing 40 lbs, mounted on a tripod weighing 58 lbs., having a maximum speed of about 480 shots per minute. One man can operate the gun, but two, one to fire and the other to enter the ammunition belts, are necessary to obtain the greatest rapidity of continuous fire with a number of belts. (Ill.) 4 col.—*Sci. Am.*, April 14th, 1900.

—— *A New American Gun.* Description of the new large gun constructed at Bethlehem under the direction of Lieut. Meigs, for the Gathman Torpedo Gun Company. The calibre is 18 in., the total weight 52 tons, and the muzzle velocity is given as 1800 foot seconds, while the weight of the projectile is 2,000 lbs. The shell contains a bursting charge of 500 lb. of nitro-glycerine. 1 col.—*Engr.*, April 20th, 1900.

Manufacture of Arms.—*The United States Armory at Springfield, Mass., U.S.A.* I. The article describes the oldest and historically most famous, if not largest, of workshops of the United States Government, and the manufacture of the American magazine rifle, *i.e.*, the Krag-Jorgensen rifle. (Ill.) 8 cols.—*Am. Mack.*, March 22nd, 1900.

—— *The United States Armory at Springfield,* II (Continuation.) This instalment deals with the Museum, the manufacture of the gun-stock, the machines and tools, &c. (Ill.) 5 cols.—*Am. Mach.*, March 29th, 1900.

—— *The United States Armory at Springfield.* III. By A. E. McCarthy and G. J. M. (Continuation.) Description of the mechanism and the manufacture of the Krag-Jorgenson gun. (Ill.) 6½ cols.—*Am. Mach.*, April 5th, 1900.

Torpedo Boats.—*Progressive Trials of the Italian Torpedo Boat, "Condor."* Description and result of the trials made in June last near Genoa of the Italian seagoing boat *Condor*, built by the Ansaldo Company at Sampierdarena. 7½ cols.—*Journ. Am. Soc. Nav. Engrs.*, Feb., 1900.

Turrets.—*The Superposed Turrets of the "Kearsarge."* The article gives a fairly full description of the ingenious system of superposed turrets, containing four guns of the main battery, devised by Lieutenant Strauss; which, with several important modifications and the addition of many more features, was carried out by Naval Constructor Woodward of the United States Navy in the construction of the American battleship *Kearsarge.* The article is of great interest, as no recent design in warship construction has produced such a widely extended discussion and is so entirely new and original. (Ill.) 2 cols.—*Sci. Am.*, April 14th, 1900. This is supplemented by an editorial on the "Trial of the Double Turret System." 1¼ col.—*Sci. Am.*, April 14th, 1900.

Warships.—*The Imperial Japanese Battleship "Asahi."* Description of a sister-ship of the *Shikishima*, which though differing considerably in appearance, in reality is different only as regards the funnels, the distribution of the 2½ pounders, the absence of a bow torpedo-tube, and the mountings of the big guns. (Ill.) 1¾ col.—*Engr.*, April 13th, 1900.

War Vessels.—*Notes on Sheathing United States Naval Academy Practice Ship, "Chesapeake."* A paper by Naval Constructor Lloyd Bankson, U.S.N., read at the general meeting of the Society of Naval Architects and Marine Engineers, in New York. The article deals with the sheathing of steel vessels with wood and describes the process of sheathing the *Chesapeake*, built by the Bath Iron Works, of Bath, Maine, U.S.A. (Ill.) 6½ col.—*Mar. Engng.*, March, 1900.

RAILWAY WORK.

1. Motive Power and Equipment.

Hospital Train.—*The Princess Christian Hospital Train for South Africa.* By H. J. Shepstone. The article gives an outline description of the military hospital train recently built by the Birmingham Carriage and Wagon Co., Ltd., which is an interesting piece of engineering and the first really efficient hospital train ever built in England. (Ill.) 2 cols.—*Sci. Am.*, March 24th, 1900.

Locomotives. — *The Four-Cylinder Compound Locomotives of the Northern Railway of France.* Full description of the special features of their engines constructed for service on the French northern railway. 2¼ cols.—*Sci. Am.*, Feb. 17th, 1900.

—— *The Colliery Locomotive.* The author points out that the early history of the locomotive engine is inseparably connected with the coal trade, and that it was a coalmaster who used the first engine which could be considered a success; he then traces the colliery locomotive through its various stages of improvement. (Ill.) 2½ cols.—*Iron and Coal Trd. Rcd.*, April 6th, 1900.

2. New Projects.

3. Permanent Way and Fixtures.

Electric Traverser.—*An Electric Traverser for Railway Carriages.* B. M. Gabouret. Extracts translated from the *Revue Générale des Chemins de Fer.* Description of an ingenious device for carrying railway carriages from one line of tracks across to adjoining rails used at the Orleans Railway Station at Paris. ⅔ col.—*Elec. Engr.*, Feb. 9th, 1900.

Grades.—*A Heavy Grade.* A short description, accompanied by a photograph, showing a stretch of road running from Maquini, Mexico, back into the silver mining district of the adjacent mountains. The cars move on a rack rail, having a gradient from 9 to 13·6 per cent. The locomotives are built by Baldwin Locomotive Works, U.S.A. ⅓ col.—*Loc. Engr.*, April, 1900.

Tunnelling.—*The Blackwall Tunnel, London.* The article gives a description of the details of construction and the main features of the well-known tunnel beneath the Thames River, which was opened to traffic in 1897, so as to compare it with the projected New York Rapid Transit Tunnel. (Ill.) 2½ cols.—*Sci. Am.*, April 7th, 1900.

4. Transportation and Conducting.

5. Miscellaneous.

Light Railways.—*Light Railways in France.* No. 1. First of a series of articles on the construction and working of French light railways, with reference to their practical points. Only completed lines are taken into consideration. 4½ cols.—*Engr.*, April 6th, 1900.

—— *The Progress of Light Railways.* The article gives statistics of the light railways licensed in 1899 in Austria-Hungary; the development of light railways in Great Britain between 1896 and 1899, and the extension of the Prussian State railways and the light railways of that country. 3 cols.—*Mitt. d. Ver. f. d. Förd. d. Loc. u. Strassenbahnw*, Feb., 1900.

Railroad Appliances.—*Automatic Air and Steam Coupler.* Description of a device that automatically couples and undercouples the air brake, air signal and steam heating pipes on passenger cars, as well as the air brake pipes only on freight cars, and has been in operation on a number of American passenger trains and freight trains for some years. 2½ cols.—*Railw. Master Mech.*, April, 1900.

—— *A New Brake Shoe Design.* Description of a decidedly novel departure in brake-shoe design, named the "interlocking" brake shoe. Its main point is the insertion of the back of a partially worn shoe into the pan of a new one and reapplying both on the brake head for service. (Ill.) 3½ cols.—*Railw. Master Mech.*, April, 1900.

Railways.—*The Extension of the Orléans Railway from its Terminus at the Walhubert Station to the Quai d'Orsay in Paris.* By Mr. E. C. Zifler, Civil Engineer. 13½ cols.—*Mitt. d. Ver. f. d. Förd. de Loc. u. Strassenbahnw.*, March, 1900.

Trans-Siberian Railway.—*The Marine Department of the Trans-Siberian Railway.* By Walden Fawcett. Description of the auxiliary water communications upon which the Trans-Siberian Railway is at present depending in an enormous degree, though they may be reduced in the future. (Ill.) 2½ cols.—*Sci. Am.*, March 31st, 1900.

—— *The Trans-Siberian Railway.* Extracts from a "Guide to the Siberian Railway recently issued by the Russian Imperial Ministry of Ways of Communication," giving statistics of traffic, &c. 1½ col.—*Engr.*, April 6th, 1900.

STREET AND ELECTRIC RAILWAYS.

Electric Railways.—*A Fine Electric Railway to be Built in Japan.* The Tokio City Railway Company of Tokio, Japan, having obtained a concession from the Tokio City Council to proceed with the construction of its proposed lines, which are to be some 200 miles in length, will expend 15,000,000 yen ($7,470,000) on the work, the various details of which are summarised in this short article. 1 col.—*Elec. Rev.* (New York), April 11th, 1900.

—— *Coventry, England, Electric Railway System.* Description of an electric line, the total length of which, at present, is 10¼ miles, and counting the two miles of double track, the track is 12½ miles. (Ill.) 3½ cols.—*Elec. Wrld. and Engr.*, April 7th, 1900.

—— *Electricity as Motive Power on Railways.* By Mr. Frahm, Inspector of Railway Construction and Traffic. The article is devoted to a review of the use of electricity on full railway lines in European countries and the United States (to be concluded). 16 cols.—*Stahl u. Eisen*, April 15th, 1900.

—— *Suspended Electric Railway.* Short description of the Barmen-Elberfeld-Vohwinkel Railway in the Wupper Valley, Germany. (Ill.) 1 col.—*Elec. Wrld. and Engr.*, March 31st, 1900.

—— *The Langen-Mono Rail Suspended Railway at Elberfeld-Barmen.* Description of this interesting type of electric railway (continued). 1½ col.—*Engrg.*, April 6th, 1900.

Electric Railways.—*The Electric Tramway Bastille-Charenton in Paris, with mixed system (underground and trolley wires)*, 7 cols.; *The Electric Tramways of Audens, France* (Ill.), 1⅔ col.; *Tramway with Accumulator System in Ostende*, 3½ cols.—*Mitt. d. Ver. f. d. Förd. d. Loc. u. Strassenbahnw.*, Feb., 1900.

—— *The Stansstad-Engelberg Railway.* Description of an extremely interesting electric railway in Switzerland, which deserves attention, not only because it represents one of the latest examples in which multiphase currents have been successfully employed for traction work, but also because in construction and working it closely resembles a line of standard gauge. (Ill.) 8½ cols.—*Contract Journ.*, April 28th, 1900.

Electric Traction.—*The Johnson-Lundell System of Electric Traction.* Description of a system of electric traction based upon the use of the Lundell dynamo, of which the promoters claim that it is the most efficient imaginable, more readily and cheaply adaptable to varying conditions than any other and more simple to handle. (Ill.) 3⅔ cols.—*Lightning*, April 26th, 1900.

Electric Tramways.—*Dublin Electric Tramways.* The growing popularity of the electric tramways in Dublin led to the decision to centralise the system and to erect a central power station on the Grand Canal Basin at Ringsend, close to the River Liffey. This work, begun in 1897, is described in the present article (to be continued). (Ill.) 6 cols.—*Elec. Rev.*, April 20th, 1900.

Traction Motors.—*Traction Motor Suspensions.* By Ernest Kilburn Scott. The article describes the various methods of suspension, such as in motors with gearing, the Sperry Suspension with bevel wheels, the Wheelbarrow Suspension, the Nose Suspension, the Swede Bar Suspension, the Yoke Suspension, the Schuckert Suspension, the Bar Suspension, the Cradle Suspension, the Walker Double Spring Suspension, and concludes with a few remarks on gearless motors. (Ill.) 2 cols. and ⅔ col. respectively.—*Elec. Rev.* (London), April 13th and 20th, 1900.

TRADE AND ECONOMICS.

1. Commerce and Trade.

2. Currency and Finance.

3. Government Control.

4. Labour.

5. Miscellaneous.

RECENT BOOKS.

Indicator Diagrams. By W. W. F. Pullen, Wh. Sc., A.M.I.C.E., &c. Scientific Publishing Co., Manchester, 1899. Demy 8vo, 230 pp., illus., 6s. net.

This book affords much serviceable information on the use of the indicator, and its perusal should be of no little assistance to those who are desirous of increasing their knowledge of this delicate and somewhat unreliable instrument and its performances.

The volume, which contains fifteen chapters and some two hundred and fifty diagrams, is full of interest. Various types of indicators are illustrated, including the Simplex, Waune, and Little instruments, which present several novel features.

Reducing gear and errors in indicators are treated of at some length, and many practical hints are given which should do much to lessen the production of the fearful and wonderful diagrams occasionally seen, due generally to the inexperience of the operator.

Nine chapters devoted to the consideration of indicator diagrams form the most important portion of the work. A representative selection of these has been obtained, exhaustively criticised and commented on. Close examination of the diagrams cannot fail to assist those who desire to become more thoroughly conversant with the subject. The clearness with which the various merits and imperfections of the examples are analysed is worthy of praise.

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The value of the work has been enhanced by the recent addition of a chapter on motors.

The subject is dealt with in a clear and intelligible manner, which any dynamo attendant should be able to comprehend.

It should be of no little assistance to all who have to do with the dynamo "in sickness and in health." The majority of the illustrations and diagrams are, however, poorly reproduced in a manner quite unworthy of the publishers' reputation.

Britannia, an Organ for United Empire Loyalists. London: P. S. King and Son, Orchard House, 2 and 4, Great Smith Street, Westminster, S.W.; and Whitefield, Govan, Glasgow. Price 6d.

We have before us the April and May issues of the above-named magazine, and we may say without hesitation that, notwithstanding the enormous amount of periodical literature published at present in Great Britain, there are but few publications that within so small a compass contain so many contributions of real literary value as these two numbers of *Britannia*. There is an excellent biographical essay on Thackeray, begun in the April and finished in the May issue, by E. Rimbault Dibdin, reminding one in style of an era of writing anteceding the prolific but hasty productivity of our own times, an era when even journalism gave birth to work of more than ephemeral value. Nor does this essay stand alone in its high aim, for the editorials, the contributions on the various "Forms of Government Existing in the British Empire" (somewhat dry, perhaps); the articles on the "Famine in India"; the "Commonwealth Bill"; the "Sugar Bounties," and many others, are distinguished by thoroughness and painstaking; while the general tone of the magazine, dignified and earnest, testifies to Mr. Robert Duncan's ability as editor of a publication which, though in a different way, pursues the same aim and object as FEILDEN'S MAGAZINE—namely, the promotion of the common interests of the widely separated parts of Greater Britain and a propaganda for all that is British in the best sense of the word. Perhaps the most striking and the most praiseworthy feature of *Britannia* is the singleness of purpose characterising both its original contributions and its compilations. The cultivation of patriotism is the unmistakable aim of all that it contains, but there is an entire absence of that injudicious exaggeration and blind Chauvinism which, instead of promoting love for one's country, are apt to disgust the most thoughtful, i.e., the best class of readers.

To all those, therefore, who desire to obtain an unprejudiced insight into questions of Imperial interest, to follow the slow but steady growth of the consciousness of solidarity of interests of the Anglo-Saxon portions of the inhabited globe and to form an opinion regarding the best way to promote these interests, we can cordially recommend to become subscribers of *Britannia*, and promise that they will not be disappointed.

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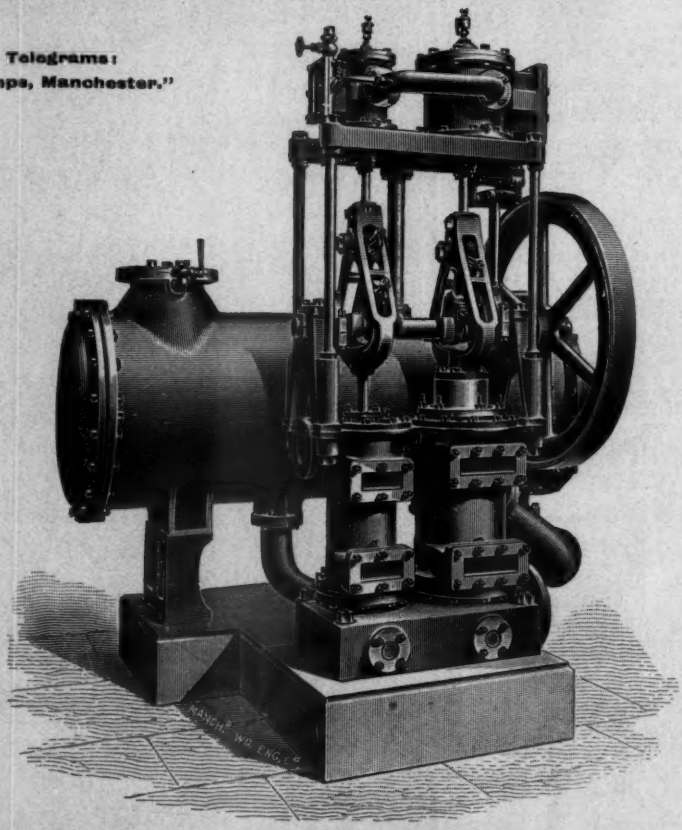

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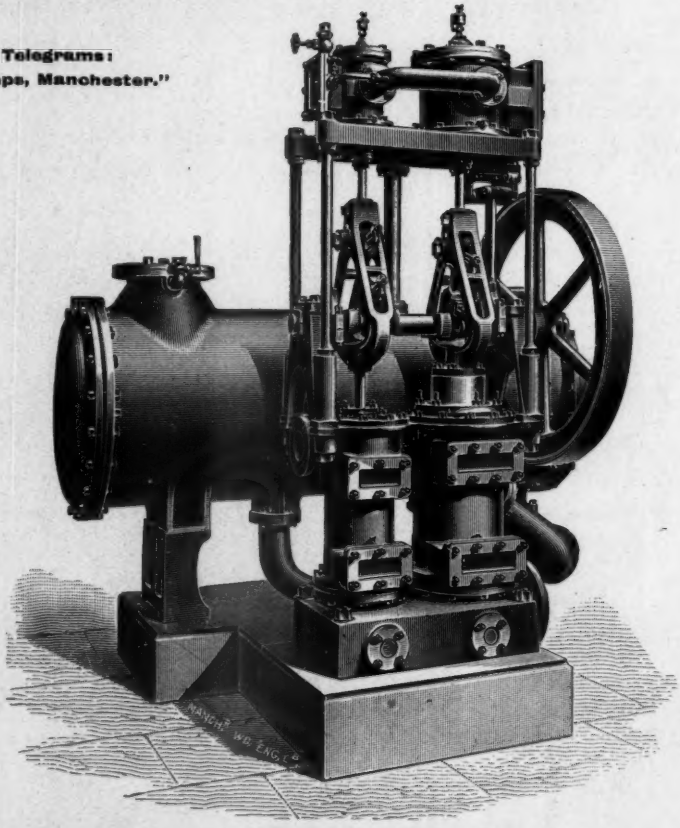

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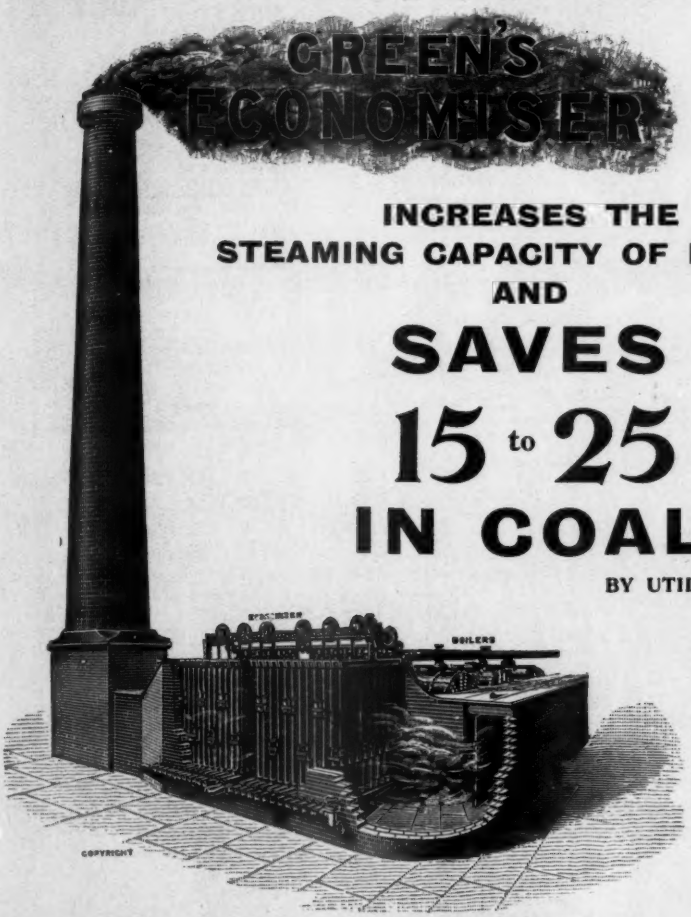

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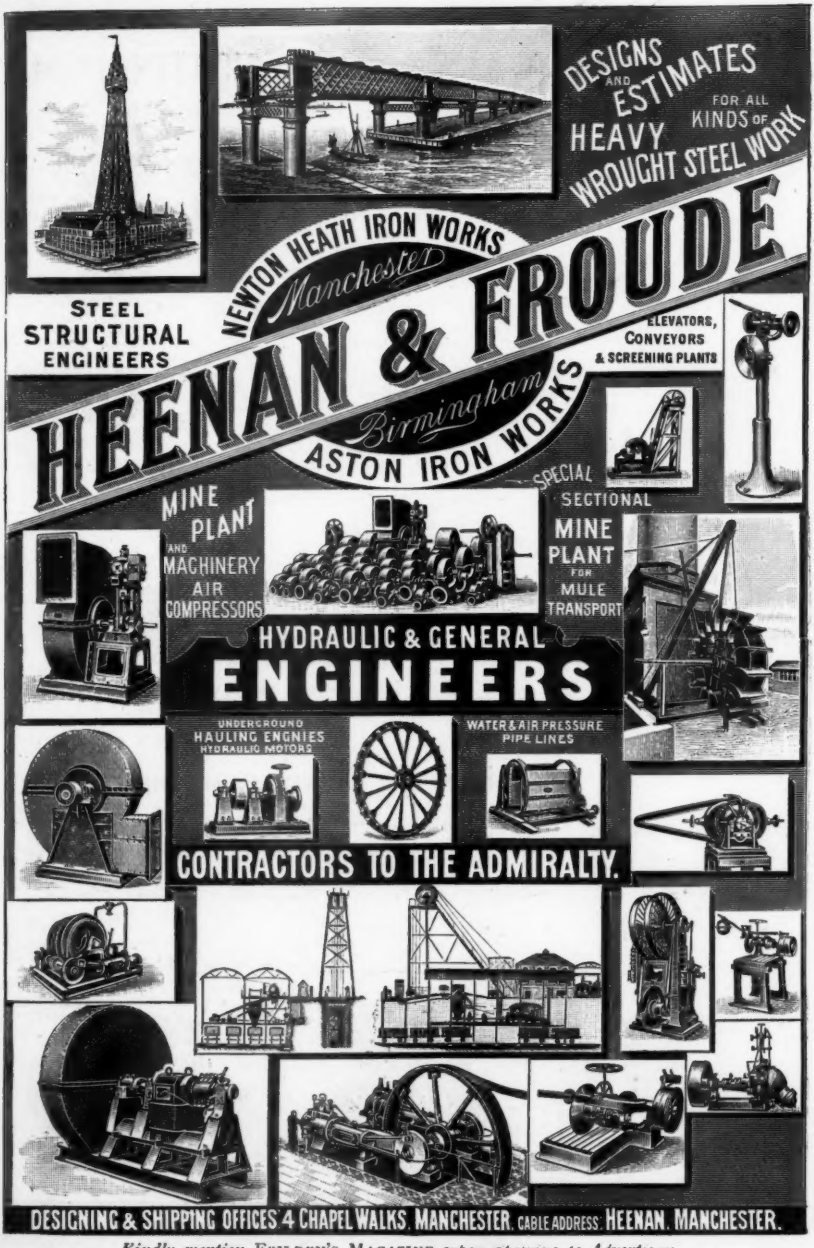
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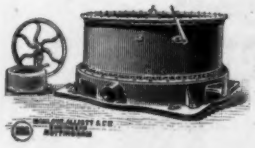

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This list contains the names, postal, telegraphic and cable addresses, and codes used, together with the specialities manufactured by

Leading British Firms in the Engineering, Shipbuilding and Allied Industries.

For the benefit of the readers of this Magazine, the proprietors have organised a special department of their business, in which the Catalogues and Price Lists of the firms named in this Directory are preserved for reference. They can be consulted free of any expense at all times by subscribers to or advertisers in FEILDEN'S MAGAZINE, and any enquiries will be freely answered either by letter or personally.

This organization possesses special facilities for securing *inside* information not otherwise obtainable. Correspondence from any part of the world will receive immediate attention, and the wants and requirements of Foreign and Colonial buyers will be catered for in a manner hitherto but imperfectly done by other agencies. The most authentic information will be vouchsafed to readers as to the merits of the respective specialities advertised.

☞ *To ascertain the Names of Firms Manufacturing any of the Specialities in the following List, take the numbers indicated against each name and refer to the corresponding numbers in the List of Firms on pages* ix., xi., *and* xiv. *Those firms whose names, addresses and numbers are indicated in heavier type, have displayed announcements in this Magazine, to which attention is directed.*

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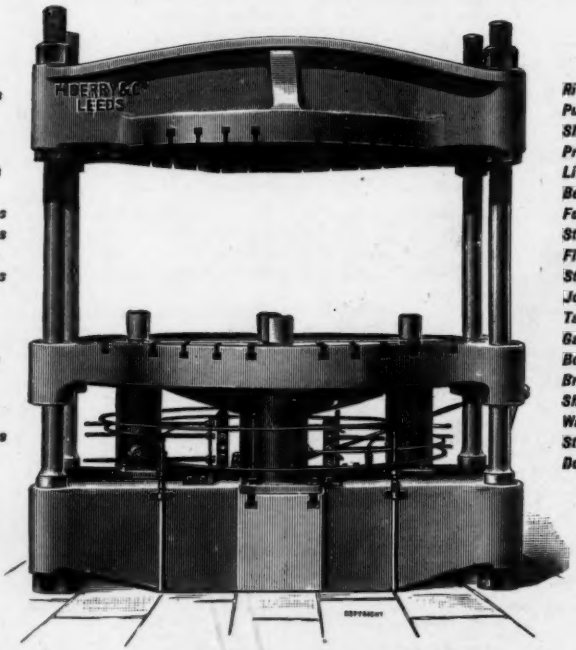

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Avec indication du genre d'industrie dont chacune de ces Maisons fait sa spécialité.

Dans l'intérêt des lecteurs de ce Journal, ses éditeurs ont organisé dans leurs bureaux un service spécial pour la conservation des catalogues et prix courants des diverses Maisons figurant dans la liste afin de pouvoir s'y reporter au besoin. Ces imprimés peuvent à tout moment être consultés, sans frais, par les abonnés du FEILDEN'S MAGAZINE et les personnes qui font paraître des annonces dans cette publication. On répond, en outre, soit par lettre affranchie, soit personnellement, à toute demande de renseignements.

☛ *Pour savoir les noms des maisons qui fabriquent quelqu'une des spécialités comprises dans la liste suivante, prendre les numéros vis-à-vis de chaque nom et chercher les numéros correspondants dans la liste des maisons, sur pages* ix, xi, *et* xiv. *Les maisons dont les noms, adresses, et numéros sont imprimés en caractères plus gras que ceux des autres ont dans ce même Magazine des annonces spéciales et detaillées auxquelles nous appelons l'attention des lecteurs.*

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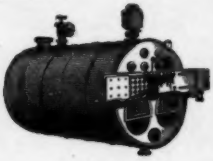

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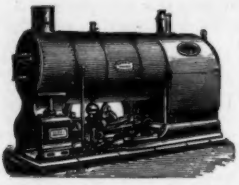

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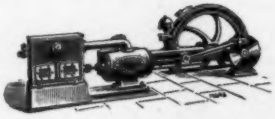

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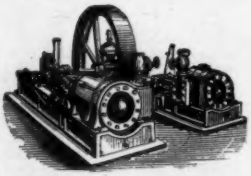

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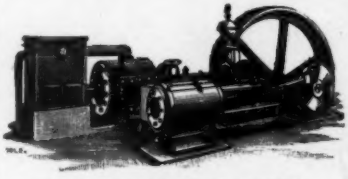

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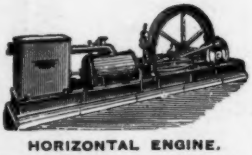

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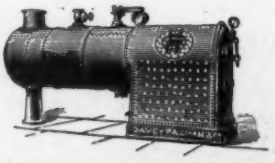

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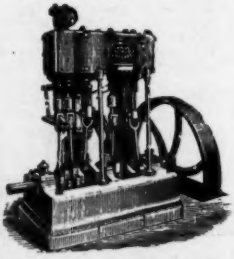

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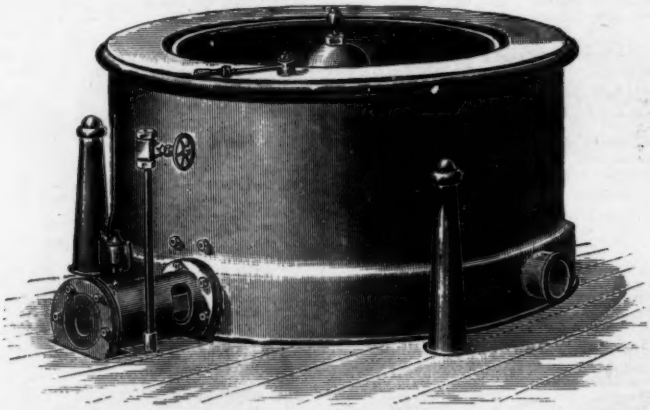

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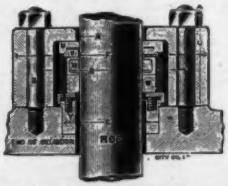

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АНГЛІЯ

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FEILDEN'S MAGAZINE: Directory *(continued).*

The numbers against the names refer to the corresponding numbers against the Specialities on pages iii, v, vii.

FEILDEN'S MAGAZINE: Annuaire de l'Acheteur.

Les numéros en regard des noms se rapportent aux numéros correspondants en regard des Spécialités aux pages iii, v, vii.

FEILDEN'S MAGAZINE: Des Käufers Rathgeber.

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		Name of Firm. / Nom de la Maison. / Name der Firm.	Postal Address. / Adresse Postale. / Postadresse.	Telegraphic or Cable Address. / Adresse Télégraphique. / Telegraphische oder Kabeladresse	Telephone No. / Telephone No. / Fernsprecher No	Codes used. / Codes. / Codes.
E	4	EBBW VALE STEEL, IRON, & COAL CO., Ltd.	Mon., S. Wales	Company, Ebbw Vale	.....	....
E	5	EDISON & SWAN UNITED ELECTRIC LIGHT CO.	36 & 37 Queen Street, Cheapside, E.C.	Ediswan, London	Bank, 1805	....
E	6	**EVANS, JOSEPH, & SONS**	Culwell Works, Wolverhampton	Evans, Wolverhampton	39	2
E	7	**EDWARDS AIR PUMP SYNDICATE, Ltd.**	3 & 5, Crown Court, Old Broad Street, E.C.	Management, London,	152 Avenue	2, 3, 9
F	2	FARNLEY IRON CO., Ltd.	Leeds	Farnley, Leeds	349	4
F	4	FIELDING & PLATT, Ltd.	Gloucester	Atlas, Gloucester	58	2
F	5	FINDLAY, ALEX. & CO.	Motherwell, N.B.	Findlay, Motherwell	.....	....
F	7	**FLEMING, BIRKBY & GOODALL, Ltd.**	West Grove Mill, Halifax	Fleming, Halifax	48	....
F	8	FLETCHER, JOHN, & SON	Eagle Foundry, Salford, Manchester	Wheels, Manchester	2084	....
F	10	FOWLER, JOHN, & CO. (Leeds), Ltd.	Steam Plough Works, Leeds	Fowler, Leeds	513	....
G	1	**GALLOWAYS, Ltd.**	Manchester	Galloway, Manchester	195	3 1, 2
G	2	**GRAHAM, MORTON & CO.**	Leeds	Accouple, Leeds	1982	.....
G	3	GARRETT, R., & SON	Leiston Works, Suffolk	Garrett, Leiston	.....	....
G	4	GLASGOW IRON & STEEL CO., Ltd.	36, S. Vincent Place, Glasgow	Ingot, Glasgow	825	....
G	5	**GIBBS, J., & SON**	12, Duke Street, Liverpool	Ventilation, Liverpool	1389 Central	.....
G	6	GLENFIELD Co., Ltd.	Kilmarnock, N.B	Glenfield, Kilmarnock	28	1
G	7	GLOUCESTER RAILWAY CARRIAGE AND WAGON CO., Ltd.	Gloucester	Slater, Gloucester	46	....
G	8	GRANTHAM, CRANK & IRON Co., Ltd.	.....	Land, Grantham	.....	....
G	9	**GREEN, E., & SON, Ltd.**	2, Exchange Street, Manchester	Economiser, Manchester	.....	....
G	10	GREEN, THOMAS & SON, Ltd.	Smithfield Ironworks, Leeds	Smithfield, Leeds	158	.....
G	11	GREENWOOD & BATLEY, Ltd.	Albion Works, Leeds	Greenwood, Leeds	270	.....
G	15	**GLOVER, W. T., & Co., Ltd**	Salford, Manchester	Phonoscope, London	.....	....
G	16	**GAUKROGER, SYKES & ROBERTS, Ltd.**	Providence Brass and Iron Works, Halifax	Brass, Halifax	204	....
H	1	HADFIELD'S STEEL FOUNDRY CO., Ltd.	Hecla Works, Sheffield	Hadfield, Sheffield	750	4, 2
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H	3	HALL, J. P., & Co.	Blackriding Ironworks, Oldham	Dynamo, Oldham	300	1, 2
H	4	HANDYSIDE, ANDREW & Co.	Britannia Ironworks, Derby	Handyside, Derby	57	.....
H	5	HARDY PATENT PICK CO., Ltd.	Sheffield	Hardypick, Sheffield	157	3, 2
H	6	**HARTLEY & SUGDEN, Ltd.**	Halifax	Boilers, Halifax	38	2
H	7	HARTNELL, WILSON	Volt Works, Kirkstall Rd., Leeds	Hartnell, Leeds	282	.....
H	8	HATHORN, DAVEY & CO.	Sun Foundry, Leeds	Hathorn, Leeds	324	.....
H	9	HAWTHORN, R. W., LESLIE & CO., Ltd.	Newcastle-on-Tyne	Locomotive, Newcastle	.....	....
H	10	HAYWARD, TYLER & CO.	90 and 92, Whitecross Street, E.C.	Tylerox, London	Bank 192	2
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H	13	**HEENAN & FROUDE**	Newton Heath Ironworks, Manchester	Spherical, Newton Heath	966	4, 2
H	13	Do.	Aston, Birmingham	Spherical, Birmingham	2628	2
H	14	**HALF TONE CO.**	Farringdon Avenue, E.C.	.....	.....	....
H	18	HERBERT, ALFRED, Ltd.	Coventry	Boiler, Coventry	52	.....
		HOLMES, J. H., & CO.	Portland Rd., Newcastle-on-Tyne	Holmes, Newcastle	6504	.....
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H	20	**HARRIS PATENT FEED-WATER FILTERS, Ltd.**	2, Hamilton Street, Greenock	Windtight, Greenock	Greenock, 127	....
H	24	HARTLEY, J. E., & SON	13, St. Paul's Square, Birmingh'm	Windtight, London	London, 973 Bank	....
I	1	INDIA RUBBER, GUTTAPERCHA, AND TELEGRAPH WORKS CO., Ltd.	Silvertown, Essex	Pyroxilin, Birmingham	2259	....
				Graysilver, London	.....	....
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J	3	JESSOP, WM., & SONS, Ltd.	Brightside Works, Sheffield	Jessops, Sheffield	152	....
K	1	KENDALL & GENT	Salford, Manchester	Tools, Manchester	330	1, 2
K	2	KERR, STUART & CO., Ltd.	90, Bucklersbury, E.C.; Stoke-on-Trent	Meliss, London; California, Stoke-on-Trent	213	....
				.....	.....	....
K	3	**KIRKHAM, HULETT & CHANDLER, Ltd.**	Westminster, London	Forge, Kirkstall	.....	....
K	4	KIRKSTALL FORGE CO., Ltd.	Leeds	Siemens, Motherwell	7	1, 2
L	1	LANARKSHIRE STEEL CO., Ltd.	Motherwell, N.B.	Macmechan, Manchester	1001	4, 2
L	3	**LANCASHIRE PATENT BELTING AND HOSE CO.**	Manchester	Pistons, Manchester	Nat.; 559 New; 5001	2
L	3	**LANCASTER & TONGE, Ltd.**	Pendleton, near Manchester	Lang, Johnstone	12	....
L	4	LANG, JOHN, & SONS	Lathe Makers, Johnstone, N.B.	Gothic, Norwich	246	....
L	5	LAURENCE, SCOTT & CO., Ltd.	Norwich	.....	.....	....
L	6	**LONDON STEREOSCOPIC CO.**	106 & 108, Regent St., W.	Vulpes, Leeds	107	....
L	7	LEEDS FORGE CO., Ltd.	Leeds	Lloyds, Birmingham	282	....
L	12	**LLOYD & LLOYD**	Albion Tube Works, Birmingham	Emery, Manchester	Altrincham, 49	....
L	15	**LUKE & SPENCER, Ltd.**	Broadheath, near Manchester	.....	.....	....
M	1	MABBOTT, THOMAS & CO.	51, Lever St., Manchester	Manloves, Nottingham	274	6, 1,
M	3	**MANLOVE, ALLIOTT & CO.**	Nottingham	Tubes, Swansea	69	2
M	4	MANNESMANN TUBE CO., Ltd.	Landore R.S.O., South Wales	Manning, Leeds	514	3
M	5	MANNING, WARDLE & CO.	Boyne Engine Works, Leeds	Marshalls, Gainsborough	10	3, 2, 1
M	6	MARSHALL, SONS & CO., Ltd.	Gainsborough	Masseys, Openshaw	300	....
M	9	MASSEY, B. & S.	Openshaw, Manchester	Macomie, Glasgow	565	....
M	11	MCONIE, HARVEY & CO., Ltd.	Scotland Street Engine Works, Glasgow	.....	.....	....
M	13	**MELDRUM, BROS.**	City Road, Manchester	Meldrum, Manchester	1674	....
M	14	MERRYWEATHER & SONS, Ltd.	63, Long Acre, W.C.	Merryweather, London	.....	....
M	18	**MESSENGER & CO., Ltd.**	Midland Horticultural Works	.....	.....	....
M	16	METROPOLITAN RAILWAY CARRIAGE CO.	Birmingham	Metro., Birmingham	2546	....
M	17	MIDDLETON, ROBERT	Shepscar Foundry, Leeds	Hydraulic, Leeds	214	2, 3, 6
M	23	MUIR, WM. & CO., Ltd.	Sherbourne Street, Manchester	Britannia, Manchester	529	....
M	20	MATHER & PLATT, Ltd.	Salford Ironworks, Manchester	.....	.....	....
M	27	**MATTHEWS & YATES, Ltd.**	Swinton, Lancs.	Cyclone, Swinton	1871, Nat.	....

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1. A1.
2. ABC.
3. Engineering.
4. Moreing's.
5. Moreing and McCutcheon's.
6. Lieber's.
7. Hawke's Premier.
8. Unicode.
9. Bedford McNeill's.
10. Ager's.

☞ FOR CONTINUATION OF DIRECTORY SEE PAGE XIV.

THE UTILIZATION OF TOWNS' REFUSE ::::: for some practical purpose has been successfully solved, and there is, therefore, no reason why every township should not have its own Electric Installation, and obtain the power from its dust bins.

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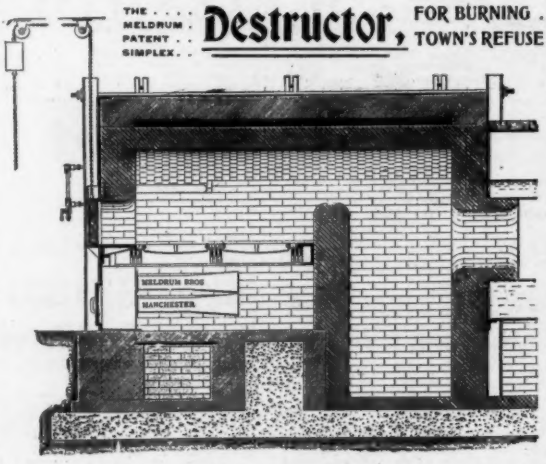

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FOYERS À TIRAGE FORCÉ.

PRODUCTION ÈCONOMIQUE DE LA VAPEUR.

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Afin de pouvoir livrer à bon-marché les produits manufacturés, il est indispensable d'en réduire le prix de revient. Quiconque utilise la force motrice, s'il lui arrive parfois de se rendre compte de ce que lui coûte le combustible nécessaire à la production de la vapeur, doit certainement se demander s'il n'existe pas quelque moyen permettant de diminuer la dépense encourue de ce chef. Or, ce moyen existe. Il suffirait, en effet, d'avoir à sa disposition un appareil remplissant certaines conditions essentielles pour pouvoir réaliser, sur ces frais, une économie de 10 à 30 %. C'est là un fait reconnu.

Si l'on vous offrait du fer, de l'acier, du coton, de la laine ou toute autre matière première dont vous pourriez vous servir pour votre genre de fabrication, à un prix réduit, ne fût ce que dans des proportions très-minimes, il va sans dire que vous examineriez une offre semblable très sérieusement. Pourquoi, dès lors, n'étudieriez vous pas avec le même soin la question du combustible, qui touche vos intérêts de si près?

Voulez-vous qu'à l'avenir l'achat du combustible vous occasionne une dépense moins forte que par le passé? Vous n'avez, pour cela, qu'à vous adresser à la Maison nommée ci-après, qui s'empressera de vous fournir les renseignements voulus.

Des milliers de ses foyers sont déjà en pleine exploitation, actuellement, dans les grands centres industriels anglais, tels que Manchester, Bolton, Oldham, Leeds, Bradford, Halifax, Glasgow; et il y en a également un grand nombre qui fonctionnent en France, en Espagne, en Russie, aux Indes, en Chine, &c.

Ces foyers conviennent à tous les types de Chaudières, utilisent toute espèce de combustible en résistence à tous les climats.

Demandez le Catalogue de la Maison:

MELDRUM BROTHERS, Ingenieurs,

ATLANTIC WORKS, CITY ROAD, MANCHESTER, ANGLETERRE.

Succursales: Paris, Moscou, Bombay, Calcutta, Shanghai, et Tokio.

Adresse Télégraphique: "Meldrum, Manchester" (ou "Londres," "Leeds" ou "Paris," suivant le cas.)

VOIR L'ILLUSTRATION A LA PAGE CI CONTRE 7.

TIRO FORZADO.

ECONOMIA EN LA GENERACIÓN DE VAPOR.

El Hogar "Meldrum."

PÍDANSE CATÁLOGOS.

Cuando rigen precios bajos en los articulos manufacturados precisa reducir el costo de su producción. Los que emplean el vapor como fuerza matriz siempre que consideran el costo del carbon consumido ven la necesidad de hallar el medio de disminuirlo y quizás no se les ocurra el hecho indiscutible de que ello se puede lograr empleando aparato adecuado, como lo es el Hogar Meldrum que produce una economia de **10 á 30 por ciento.** Todo Industrial al comprar los materiales que emplea, sean hierro, acero, lana, algodon ú otro cualquiera, estudiaria y de aprovecharia de la mas ínfima ventája que viese en los precios; pues bien, por que no ha de merecer el mismo detenido estudio la economia en el consumo de carbon, que tanto contribuye á aumentar las utilidades? Los que deseen este ideal escriban á Meldrum Bros., Ingenieros, de Manchester, pidiéndoles detalles, quienes con gusto los suministrarán. Se cuentan por miles los Hogares Meldrum hoy empleados con éscito en Manchester, Bradford, Bolton, Oldham, Leeds, Halifax, Glasgow, Francia, Espana, Rusia, India, China, etc., etc., etc.

Hay 6000 en uso. Mas Vapor. Menos Costo.

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Zur Herstellung billiger Manufacturwäaren ist offenbar eine entsprechende Herabsetzung der Fabrikationskosten unerlässlich. Jeder Consument motorischer Kraft, der gelegentlich seine Kohlenrechnung prüft, muss unzweifelhaft auf ein Mittel bedacht sein, seine Auslagen für Heizmaterial zu ermässigen. Das Mittel hiezu ist nunmehr vorhanden: mit Hülfe eines eigens zu diesem Zwecke eingerichteten Apparates lässt sich in dieser Hinsicht eine Ersparniss von 10 bis 30 % erzielen. Diese Thatsache steht fest. Wird einem Industriellen Eisen, Stahl, Baumwolle, Wolle oder etwa ein anderes in seiner Geschäftsbranche verwendetes Rohmaterial zu einem Preise offerirt, der auch nur um ein geringes den bisherigen Notirungen für diese Artikel nachsteht, so verfehlt er wohl nicht das betr. Angebot reiflich in Erwägung zu ziehen. Warum sollte er denneine Frage, die seinen Reingewinn ebenso wesentlich zu beeinflussen vermag, nicht gleichfalls einer eingehenden Prüfung unterziehen? Er braucht sich ja lediglich an die nachstehend genannte Firma zu wenden um hierüber jeden erwünschten Aufschluss zu erlangen! Tausende der varliegenden Feuerungen sind bereits in vollem Betrieb, sowohl in Manchester, Bolton, Oldham, Leeds, Bradford, Halifax, and Glasgow, als auch in Frankreich, Spanien, Russland, Indien, China, und überhaupt in zahlreichen Guwerbsstädten des In-und Aus-landes.

Die Feuerung eignet sich für Dampfkessel aller Art, Kannmittelst beliebigen Brennmaterials betrieben werden und wird von Klimatischen Verhältnissen nicht beeinflusst.

Behufs Zusendung eines Catalogs wende man sich gefäl ligst an die:

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FEILDEN'S MAGAZINE: Directory *(continued).*
The numbers against the names refer to the corresponding numbers against the Specialities on pages iii, v, vii.

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FEILDEN'S MAGAZINE: Des Käufers Rathgeber.
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		Name of Firm. / Nom de la Maison. / Name der Firm.	Postal Address. / Adresse Postale. / Postadresse.	Telegraphic or Cable Address. / Adresse Télégraphique. / Telegraphische oder Kabeladresse.	Telephone No. / Telephone No. / Fernsprecher No.	Codes used. / Codes. / Coden.
M	28	MORISON BROS.	52 Renfield St., Glasgow	Drawing, Glasgow	1034	
M	29	MACLELLAN, P. & W., Ltd.	129, Trongate, Glasgow	Maclellan, Glasgow		
M	30	McNEIL, CHAS.	Kinning Park Ironworks, 270, West Scotland St., Glasgow	Macneil, Glasgow	1556	
M	31	MIRRLEES, WATSON & YARYAN CO., Ltd.	45, Scotland Street, Glasgow	Mirrlees, Glasgow		
N	1	NAPIER, BROS., Ltd.	100, Hyde Park Street, Glasgow	Windlass, Glasgow	714	2, 1
N	2	NEW CONVEYOR CO., Ltd.	3 & 4, Lime Street Square, E.C.	Laborless, London		
O	2	OLDBURY RAILWAY CARRIAGE & WAGON CO., Ltd.	Oldbury Works, near Birmingham			
O	3	OLDHAM BOILER WORKS CO., Ltd.	Oldham	Boilers, Oldham	16	
P	1	PARSONS, C. A., & CO.	Heaton Works, Newcastle	Turbo, Newcastle-on-Tyne	1618	
P	2	PATENT EXHAUST STEAM INJECTOR CO., Ltd.	St. Ann's Square, Manchester	Exhaust, Manchester		
P	3	PARKINSON, J.	Canal Ironworks, Shipley	Temples, Shipley	80	
P	5	PEARN, FRANK, & CO., Ltd.	West Gorton, Manchester	Pumps, Manchester	1021	1, 2
P	7	PHOSPHOR BRONZE CO., Ltd.	Summer Street, S.E.	Phosphor Bronze, London	Hop. 4537	
P	7	PATENT AXLE-BOX & FOUNDRY CO., Ltd.	Saltley Works, Birmingham	Beuthers, Birmingham	2589	2
P	8	PEARSON, E. J. & J. Ltd.	Stourbridge	Firebrick, Brierley Hill	Brierley Hill, 9	
P	8	PIGGOTT, THOS., & CO., Ltd.	Birmingham	Atlas, Birmingham	86	2, 1
P	9	PARKER FOUNDRY CO.	Brunswick Iron & Steel Works, Derby	Parker, Derby	366	
R	1	RANSOMES, SIMS & JEFFRIES	Orwell Works, Ipswich	Ransomes, Ipswich	11	1
R	2	REEVES CHEMICAL SANITATION, LTD.	17, Victoria Street, Westminster			
R	2	ROSS & DUNCAN	Whitefield Works, Glasgow	Whitefield, Glasgow		1, 2
R	5	RECORD CABINET CO.	5, Billiter Street, E.C.			
R	6	REUPERN & CO., G. F.	4, South Street, Finsbury, E.C.	Invention, London	723	
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R	10	RELIANCE LUBRICATING OIL CO.	19 & 20, Water Lane, Great Tower Street, E.C.	Substral, London	Avenue, 5891	2
R	14	RUTHERFORD, A. & CO.	Neptune Works, Birkenhead			
R	17	RUSTON, PROCTOR & CO., Ltd.	Sheaf Ironworks, Lincoln	Ruston, Lincoln	56	
R	18	RYDER, WM.	Beehive Works, Bolton	Beehive, Bolton	55	
R	19	ROBLING & APPLEBY	Trafalgar Works, Bradford	Magneto, Bradford	844, Bradford	
R	20	RICHARDSON, ED. & JAMES	Elswick Leather Works, Newcastle-on-Tyne	Leather, Newcastle-on-Tyne	18	
R	21	ROBINSON & SON, Ltd.	Railway Works, Rochdale	Robinson, Rochdale	62	1, 2,
S	1	SEPTIC TANK SYNDICATE, Ltd.	7 & 8 Bedford Circus, Exeter; 25, Victoria St., Westminster, S.W.	Commin, Exeter; Sept, London	76 Exeter	2
S	2	SCOTT, E., & MOUNTAIN, Ltd.	Close Works, Newcastle-on-Tyne	Esco, Newcastle-on-Tyne	1259; P. O. 432	
S	3	SMITH, JOHN & CO.	Carshalton, Surrey			
S	4	SHANKS, THOS., & CO.	Union Ironworks, Johnstone, near Glasgow	Shanks, Johnstone	5	
S	5	SIEMENS, BROS., & CO., Ltd.	12, Queen Anne's Gate, Westminster, S.W.	Siemens, London	Westminster, 3099	1
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S	7	SUTCLIFFE & SUTCLIFFE	Fieldhead Works, Manchester	Integrity, Manchester	196, Ashton	
S	8	SMITH & COVENTRY, Ltd.	Gresley Ironworks, Ordsal Lane, Manchester	Gresley, Manchester	564, New, 1007	
S	9	SWIFT, GEORGE	St. Thomas Street, Halifax	Swift, Clarem'nt, Halifax	497	
S	10	SMITH, THOS.	Steam Crane Works, Rodley, near Leeds	Smith, Rodley	2018	
S	11	SMITH, FREDERICK & CO., LTD.	Caledonia Works, Halifax	Smith, Halifax		
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S	16	STEAM BOILERS CIRCULATOR COMPANY, Ltd.	43, Barton Arcade, Manchester			3, 2, 1
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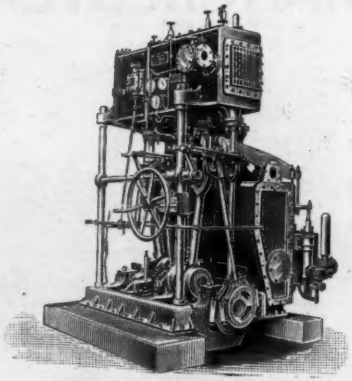

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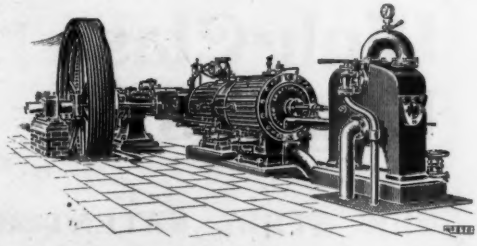

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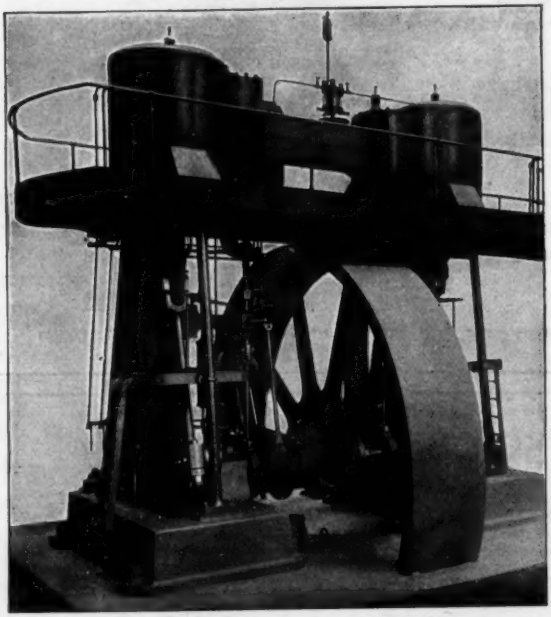

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Some of the subjects to be dealt with are enumerated on p. 469 of current issue (title-page).

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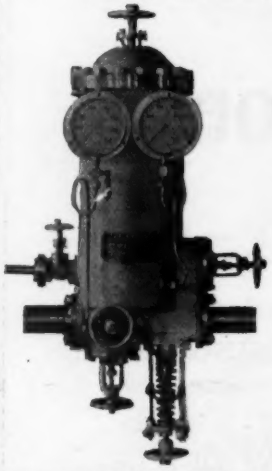

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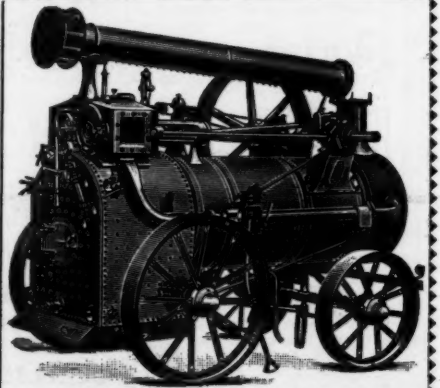

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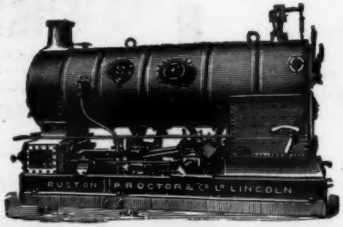

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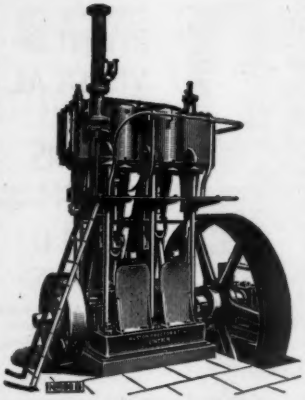

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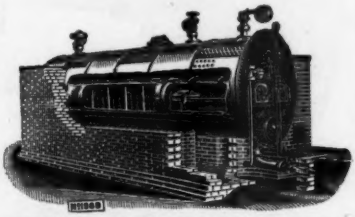

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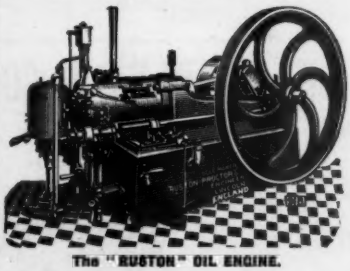

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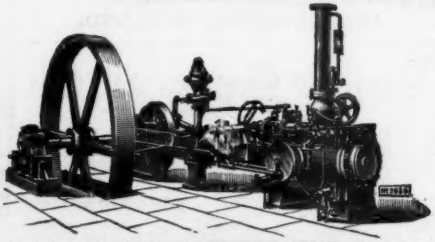

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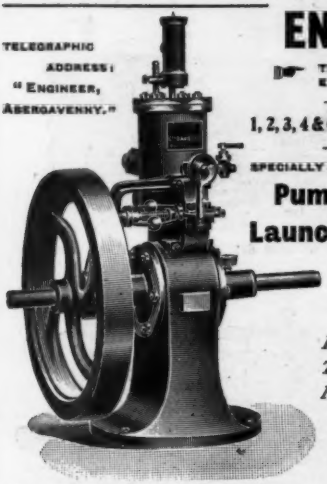

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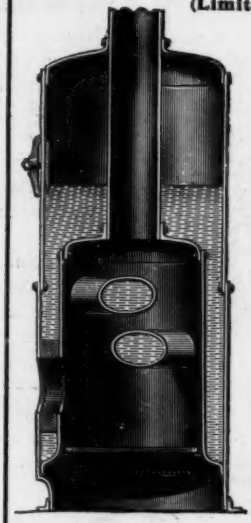

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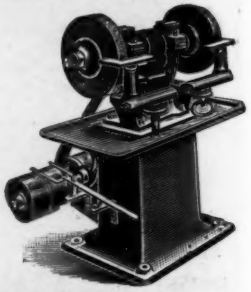

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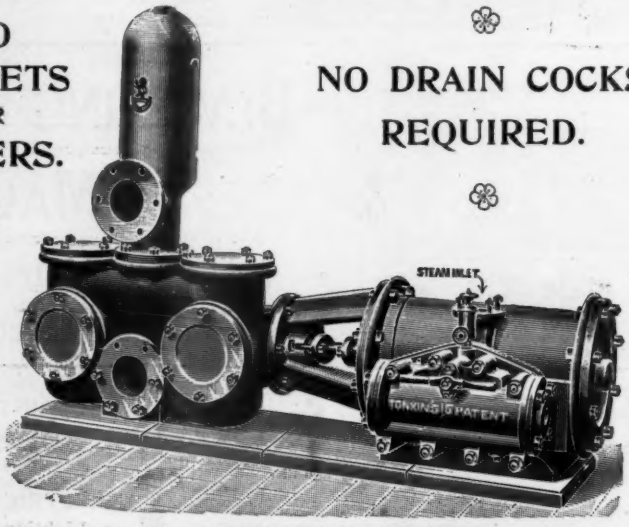

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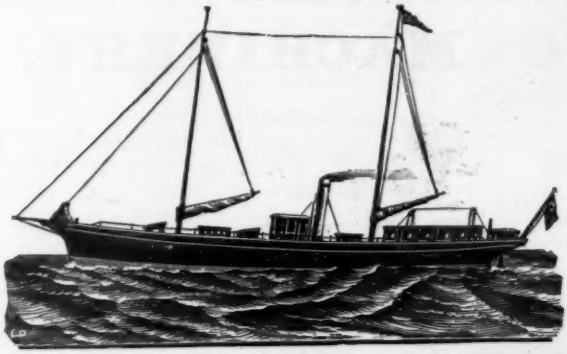

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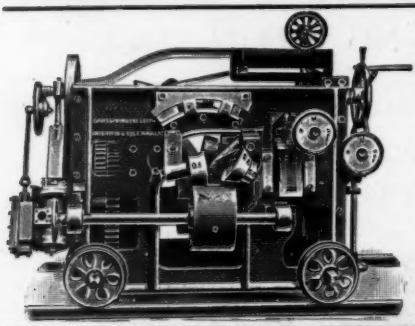

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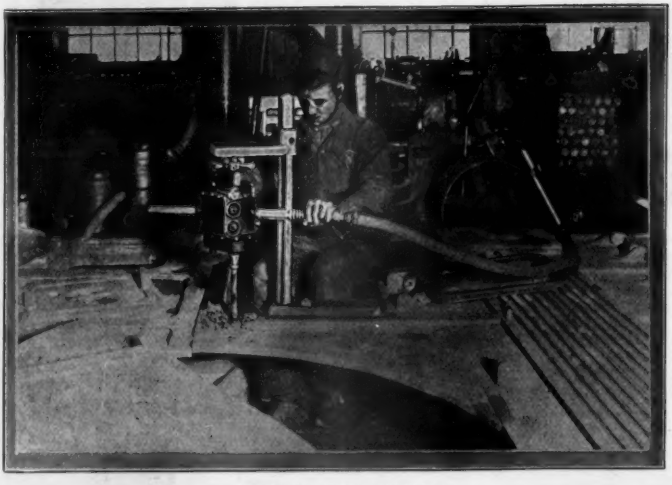

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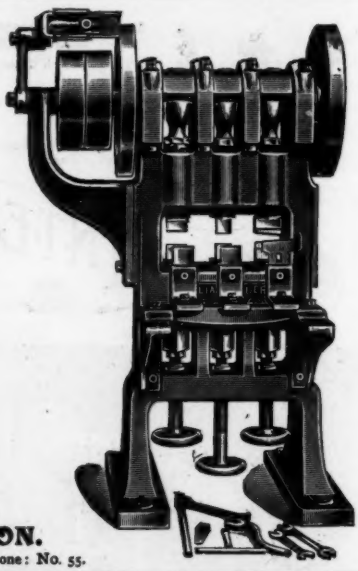

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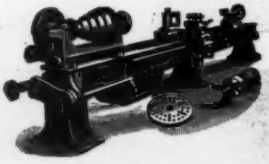

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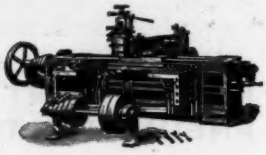

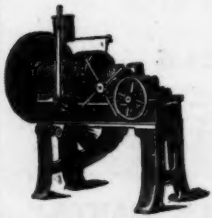

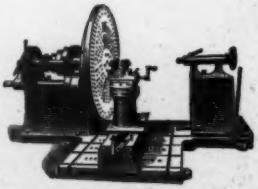

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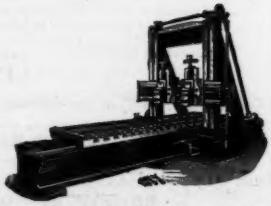

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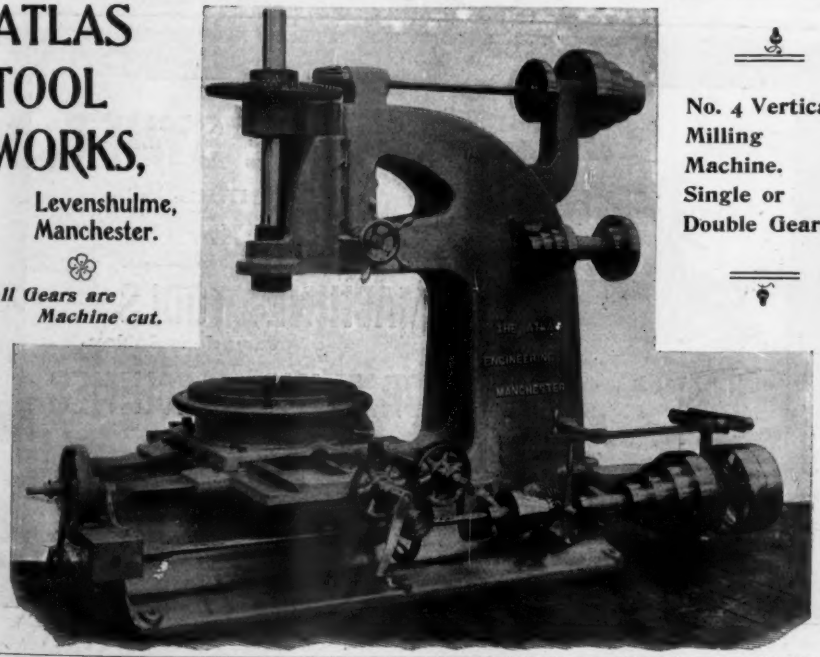

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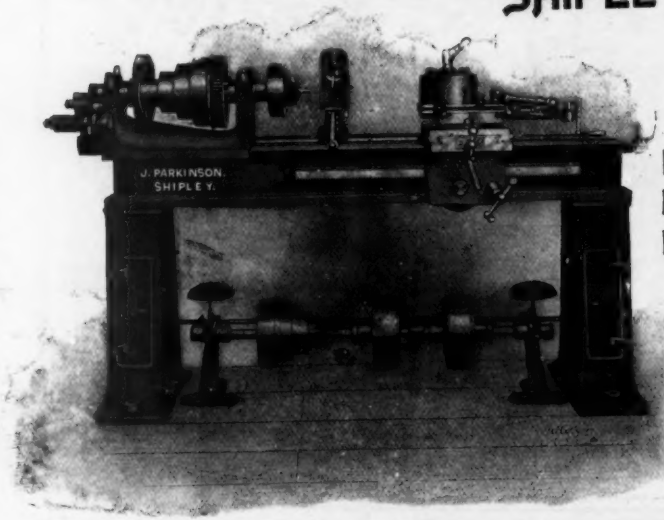

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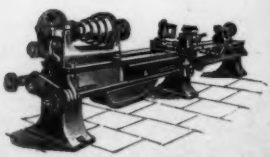

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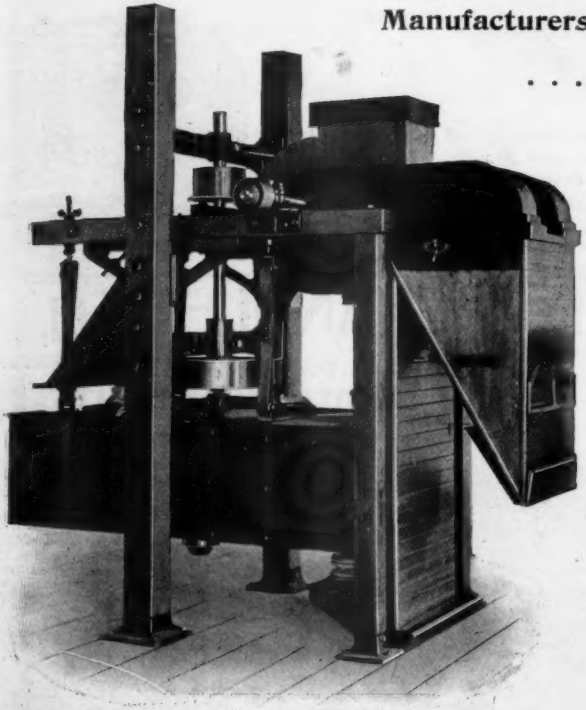

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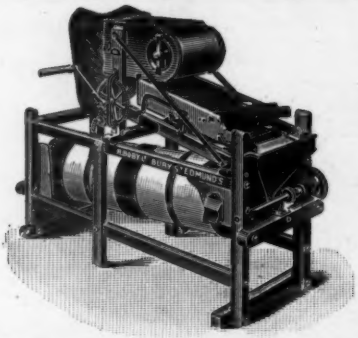

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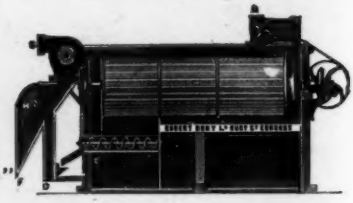

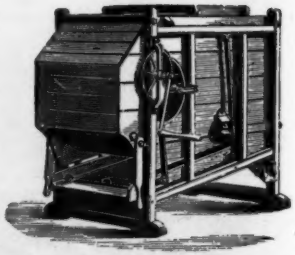

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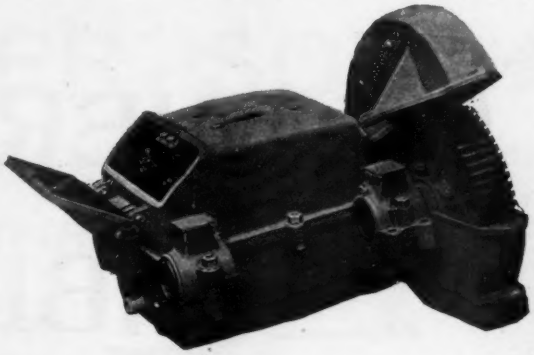

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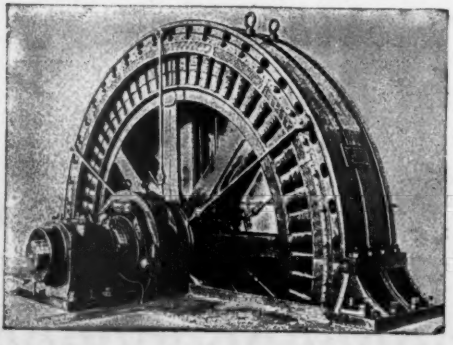

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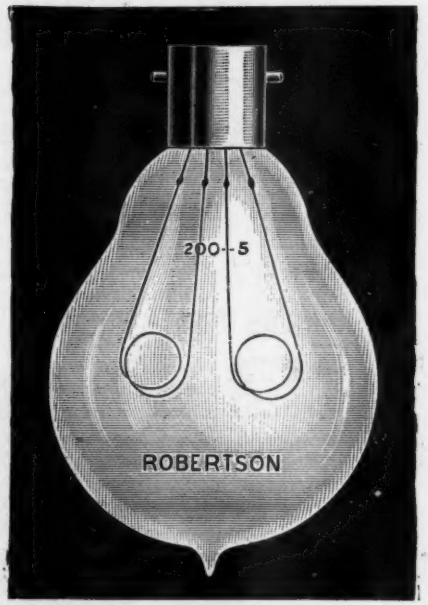

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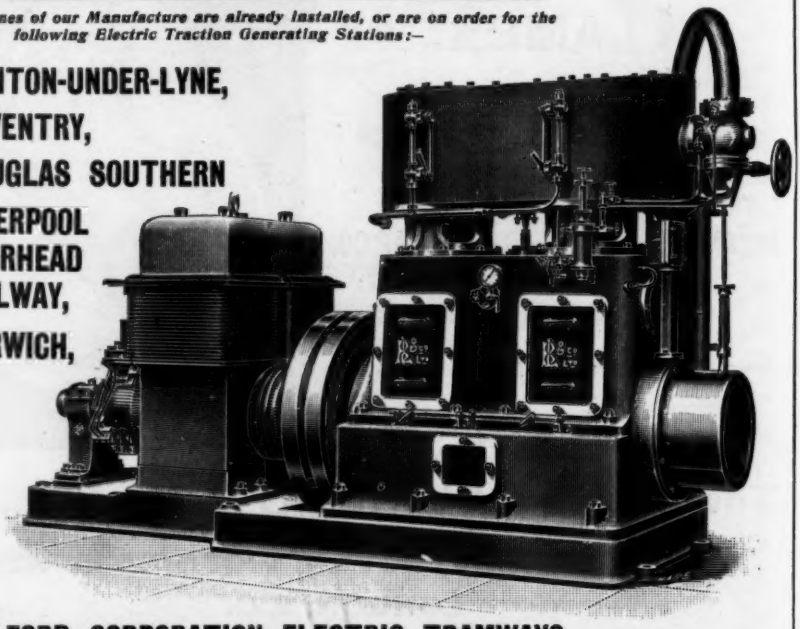

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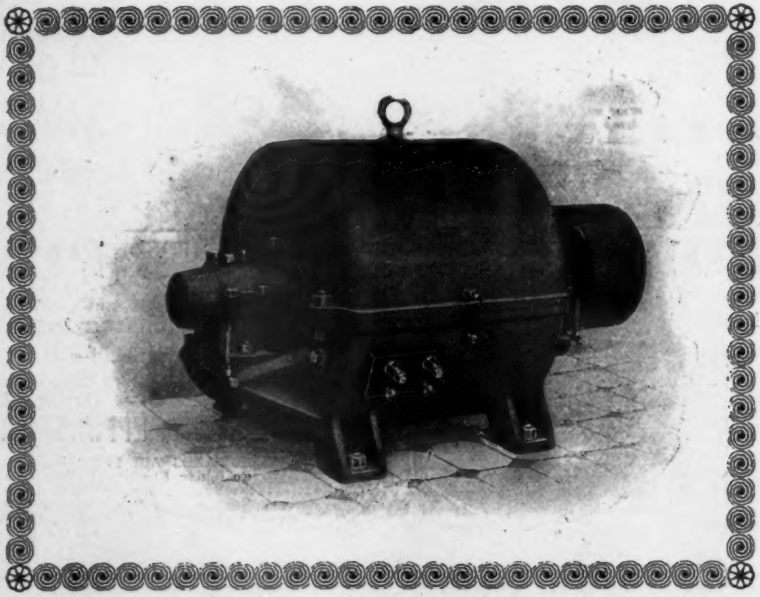

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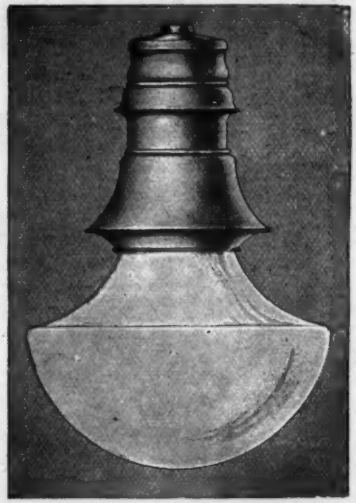

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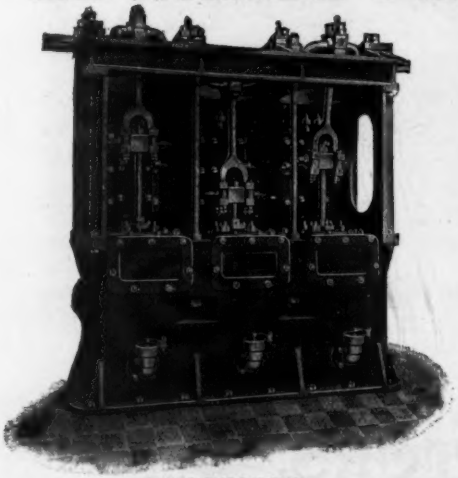

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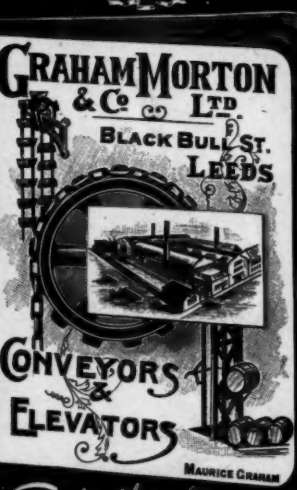
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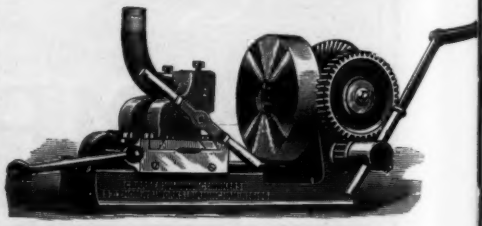
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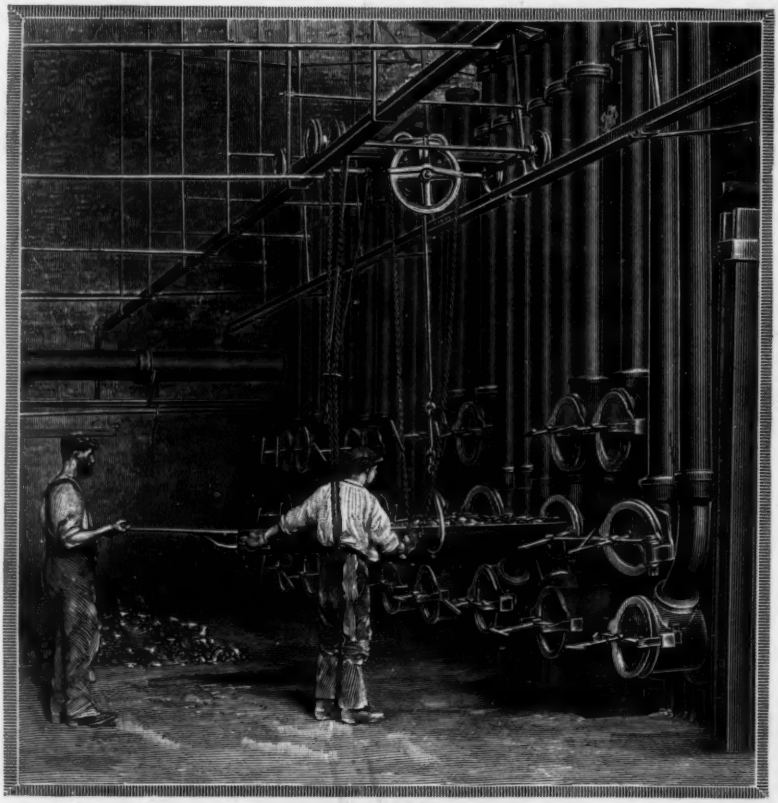

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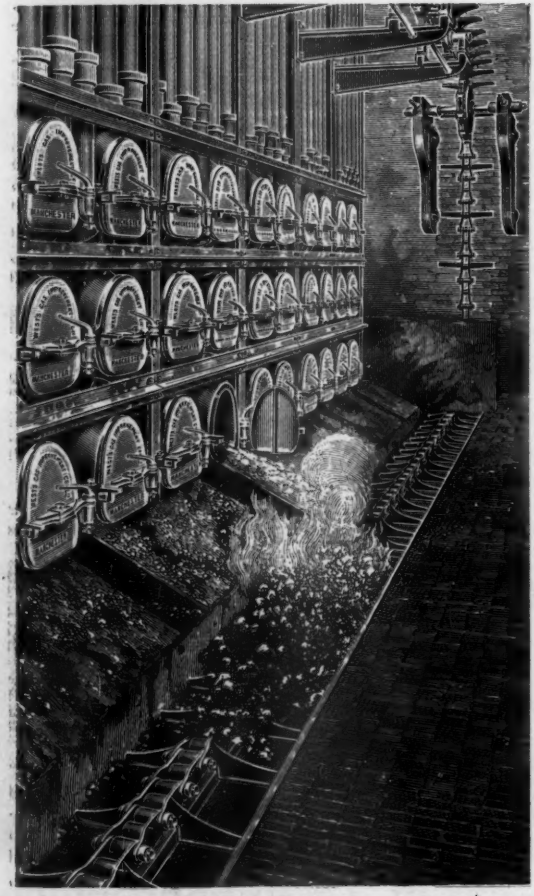

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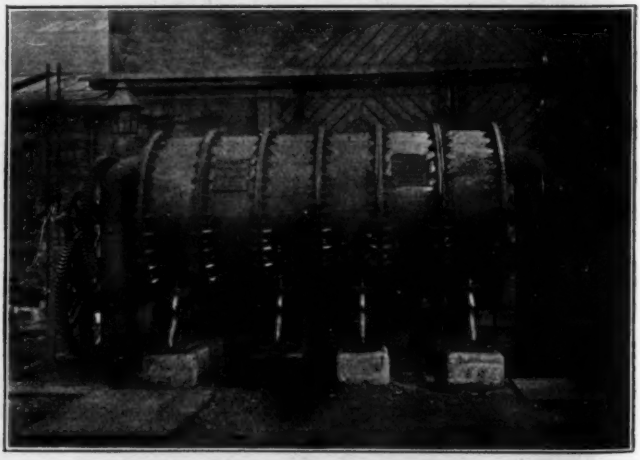

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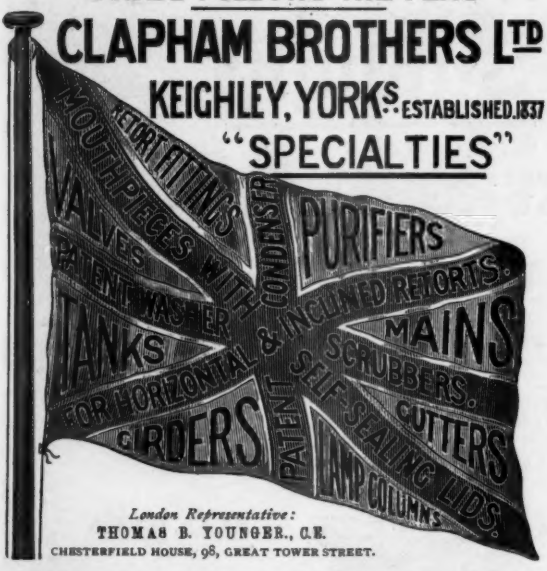

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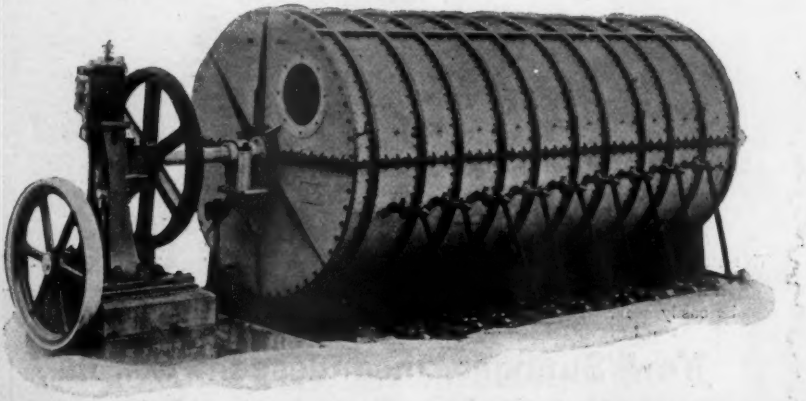

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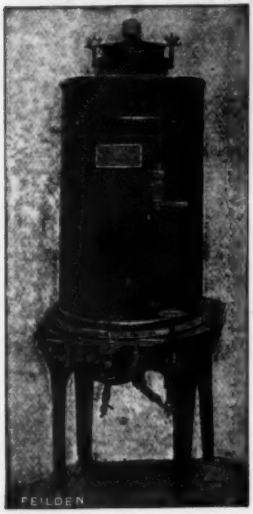

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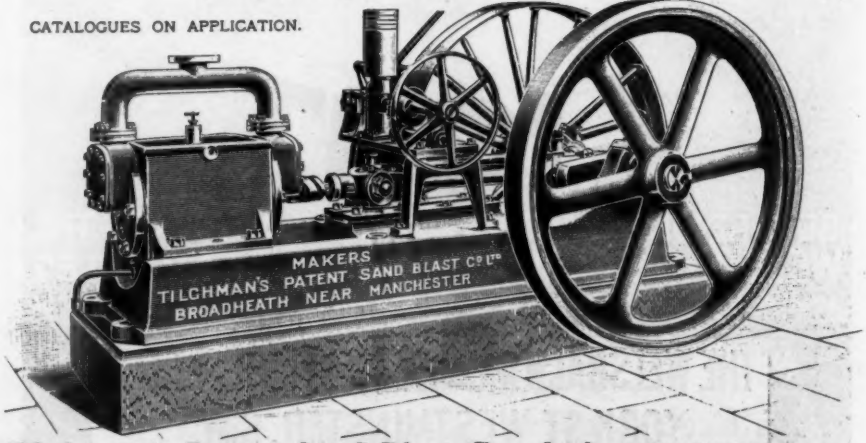

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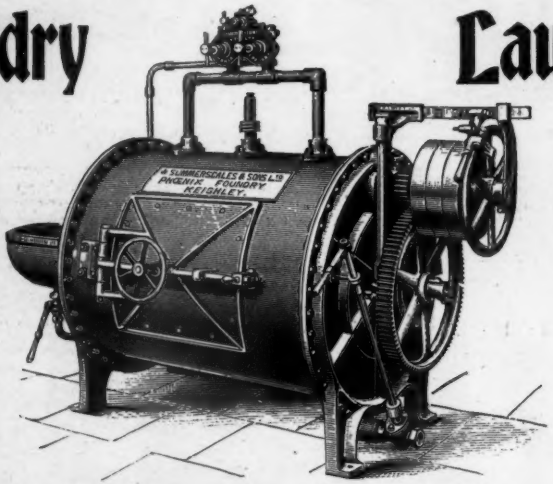

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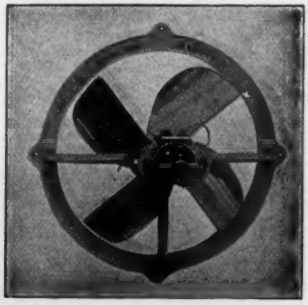

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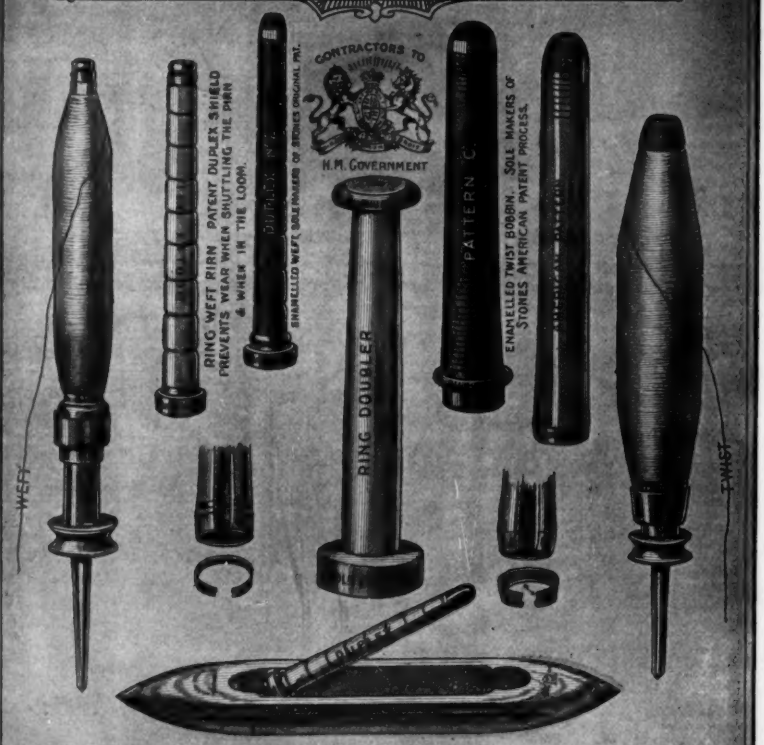
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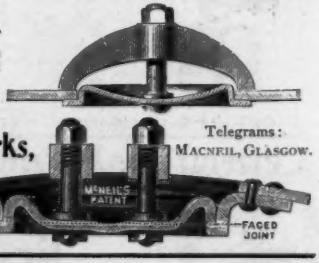

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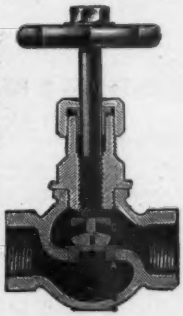

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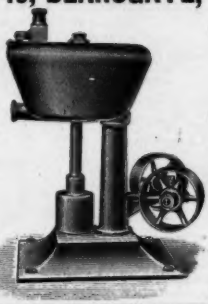

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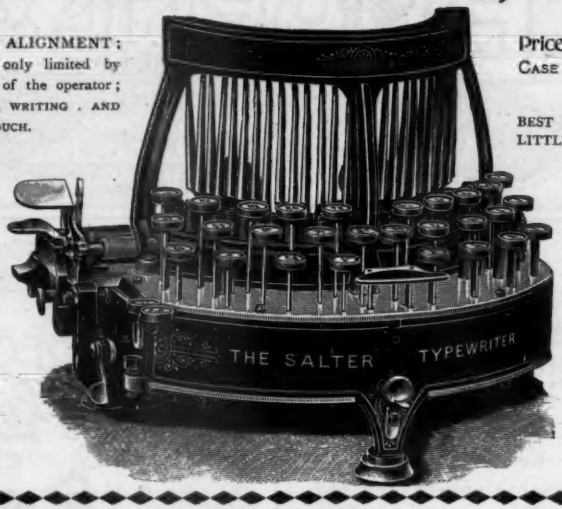

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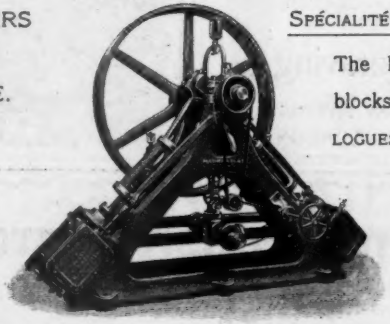

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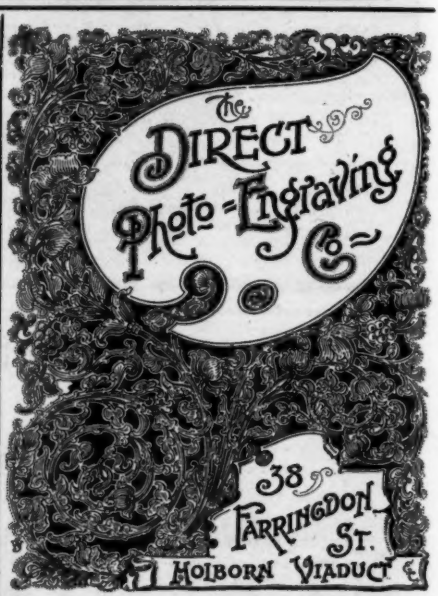

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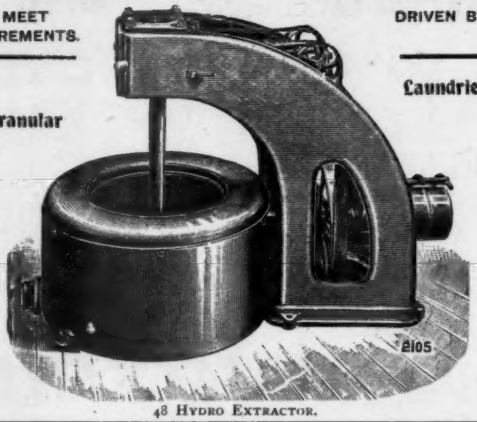

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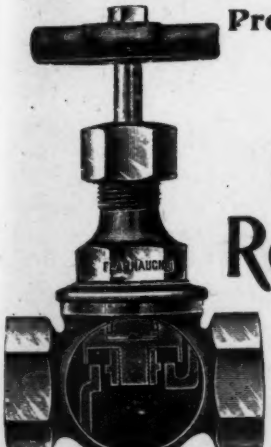

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